CLIMATE ACTION WEBINARS

Wednesday, April 10
12:00P | 1 LU/HSW | 1hrs of ZNCD MCE
(pending approval)

CALGREEN EMBODIED CARBON SERIES

Implications of Material Procurement for Design Professionals

AIA California

SEAOC
STRUCTURAL ENGINEERS ASSOCIATION OF CALIFORNIA

Learning Objectives

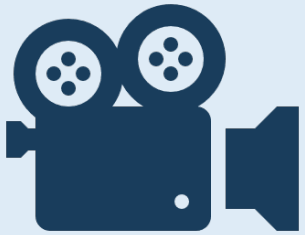
Review the CALGreen-mandated GWP limits for a variety of building materials and learn how to navigate the code to locate this information.

Examine the environmental and structural implications of utilizing low-carbon concrete in different project elements.

Trace the supply chain of fabricated steel highlighting stages that ensure code compliance, construction needs, and sustainability goals.

Explore tools that are compliant for completing the CALGreen WBLCA performance pathway.

Housekeeping Reminders



Access to today's recording will be made available on our website

Today's session qualifies for 1 AIA HSW/LU & 1hr of ZNCD

Please use the Q&A function to ask questions for today's presenters

Cultivate a positive learning environment

Luke Lombardi, PE
Sr. Sustainability
Consultant, Buro Happold

Avideh Haghighi, AIA, LFA
Associate Principal
Sustainable Design Lead, ZGF

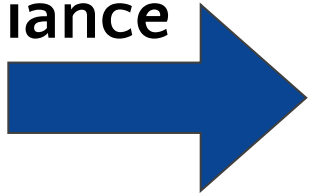
CALGreen Embodied Carbon Series

4-part series made in partnership with SEAOC's Sustainable Design Committee

Feb. 21, 2024	Understanding the 2023 Embodied Carbon Amendments
Mar. 13, 2024	WBLCA for Code Compliance
Apr. 10, 2024	**Implications of Material Procurement for Design Professionals**
June 12, 2024	Building Reuse for Decarbonization and Compliance

Refresher from last webinar

- Starting July 2024
- Non-residential buildings over 100,000 sf
- Schools over 50,000 sf
- **Three compliance pathways**



CALGREEN EMBODIED CARBON OPTIONS

Building Reuse Section 5.105, Deconstruction and Reuse of Existing Structures	Life Cycle Analysis Section 5.409, Life Cycle Assessment	Prescriptive Path Section 5.409.3, Product GWP Compliance
Components: Existing primary structural elements, enclosure, (roof framing, wall framing, and exterior finishes). **Exceptions:** Additions 2x the area or more of the existing building. **Exclude:** Window assemblies, insulation, portions structurally unsound or hazardous, and hazardous materials that are remediated as part of the project shall not be included in the calculation.	**Scope:** 60-year cradle-to-grave WB LCA (ISO 14044), excluding operating energy. Show GWP analysis. **Components:** Primary and secondary structural members, glazing, insulation, exterior finishes.	**Components:** Structural steel, rebar, flat glass, light and heavy-duty mineral wool insulation, and ready mix concrete. **Exception:** Concrete mixes can use a weighted average for all mixes.
Mandatory 45% of the structure and enclosure to be reused	**Mandatory** 10% reduction from baseline	**Mandatory** 175% of IW-EPD GWP Limits
Tier 1 75% of the structure and enclosure to be reused	**Tier 1** 15% reduction from baseline	**Tier 1** 150% of IW-EPD GWP Limits
Tier 2 75% of the structure and enclosure to be reused AND 30% of interior non-structural elements to be reused	**Tier 2** 20% reduction from baseline	**Tier 2** IW-EPD GWP Limits

California Energy Codes and Standards: CALGreen Embodied Carbon Requirements Fact Sheet

Is my project covered by the measure?

Covered

Public Schools (K-12), Community College >50,000 sf

Building types covered by *CALGreen Non-residential Provisions* and >100,000 sf

- Industrial
- Commercial Office
- Retail
- Lab
- Private School (K-12)
- University Academic (Public & Private)
- Institutional / Civic

Not Covered

Public Schools (K-12), Community College <50,000 sf

Hospitals - *pending OSHPD approval*

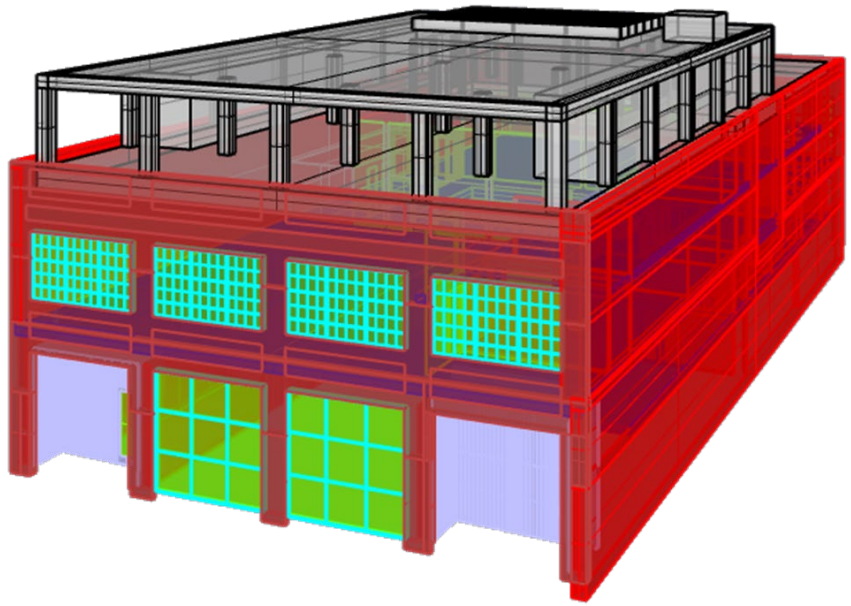
Building types covered by *CALGreen Non-residential Provisions* and <100,000 sf

Building types covered by *CALGreen Residential Provisions*

- Single Family Residential
- Multifamily Residential
- Hotel / Motel / Lodging
- University Housing (***Note that Public University Housing IS covered by Buy Clean CA)***

Last Webinar: WBLCA

Sample Building



CALGreen Reporting Template

CALGreen Whole Building LCA Reporting Template

LCA model run	User input	Units	Overall scope included (select all that apply)
LCA Modeler (company) *[private]*			Structure (required) ☐
Date of Model Run (mm/yyyy)			Envelope (required) ☐
Project Phase at Model Run			Interiors (optional) ☐
Reference Study Period (years)			MEP (optional) ☐
Software and Version Used*			Site/Landscaping (optional) ☐
Biogenic Carbon Sequestration (kg)			FF&E (optional) ☐
Model Floor Area		m2	

Mandatory Scope Items

Please break out the following in per element emissions by life cycle in kgCO2e. Leave blank any sections that were not calculated separately from Whole Building GWP

	Upfront Carbon			Use Phase	End of Life	Total
	A1-3	A4	A5	B1-5	C1-4	
Baseline Structure GWP (kgCO2e):						
Baseline Enclosure GWP (kgCO2e):						
Baseline Whole Building GWP (kgCO2e):						
Proposed Structure GWP (kgCO2e):						
Proposed Enclosure GWP (kgCO2e):						
Proposed Whole Building GWP (kgCO2e):						

Percent Reduction	
Mandatory	
Tier 1	
Tier 2	

A1-A3*
(A1) Raw Material Supply, (A2) Transport to Factory, and (A3) Manufacturing

A4*
(A4) Transportation to site

A5*
(A5) Construction Installation or "on-site energy use". Leave blank if unkown

C1-C4*
(C1) Deconstruction/Demolition, (C2) Transport to Waste Processing/Disposal, (C3) Waste Processing, (C4) Disposal of Waste

B1-B5*
(B1) Use, (B2) Maintenance, (B3) Repair, (B4) Replacement, (B5) Refurbishment

D*
(D) Reuse-Recovery & Recycling Potential

Optional Items - Proposed Design ONLY

Please break out the following in per element emissions by life cycle in kgCO2e. Leave blank any sections that were not calculated separately from Whole Building GWP

	Upfront Carbon			Use Phase	End of Life	Total
	A1-3	A4	A5	B1-5	C1-4	
Interiors GWP (kgCO2e):						
MEP GWP (kgCO2e):						
Site/Landscaping GWP (kgCO2e):						
FF&E GWP (kgCO2e):						

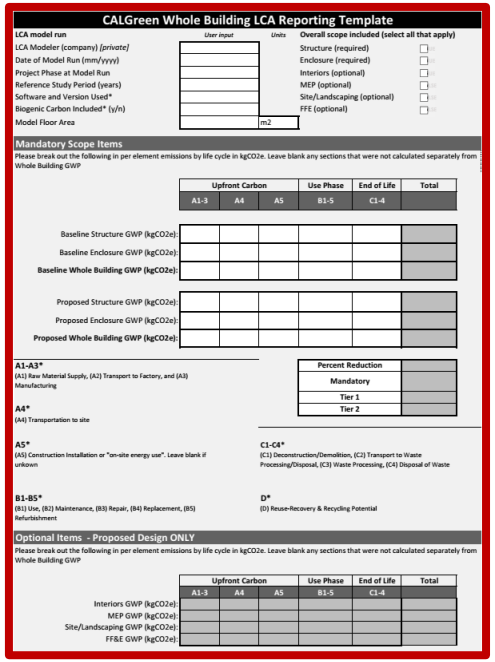
Reporting Template Submitted at Permitting

Understand overall impact to inform system selection

Estimate and document reduction measures

*WBLCA

In Drawing or Specs:



CALGreen Whole Building LCA Reporting Template

LCA model run

	User input	Units
LCA Modeler (company) *[private]*		
Date of Model Run (mm/yyyy)		
Project Phase at Model Run		
Reference Study Period (years)		
Software and Version Used*		
Biogenic Carbon Included* (y/n)		
Model Floor Area		m2

Overall scope included (select all that apply)

- Structure (required)
- Enclosure (required)
- Interiors (optional)
- MEP (optional)
- Site/Landscaping (optional)
- FFE (optional)

Mandatory Scope Items

Please break out the following in per element emissions by life cycle in kgCO2e. Leave blank any sections that were not calculated separately from Whole Building GWP

	Upfront Carbon			Use Phase	End of Life	Total
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Baseline Enclosure GWP (kgCO2e):						
Baseline Whole Building GWP (kgCO2e):						
Proposed Structure GWP (kgCO2e):						
Proposed Enclosure GWP (kgCO2e):						
Proposed Whole Building GWP (kgCO2e):						

Percent Reduction	
Mandatory	
Tier 1	
Tier 2	

A1-A3* (A1) Raw Material Supply, (A2) Transport to Factory, and (A3) Manufacturing

A4* (A4) Transportation to site

A5* (A5) Construction Installation or "on-site energy use". Leave blank if unkown

B1-B5* (B1) Use, (B2) Maintenance, (B3) Repair, (B4) Replacement, (B5) Refurbishment

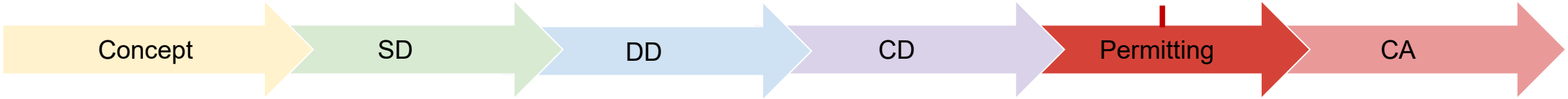
C1-C4* (C1) Deconstruction/Demolition, (C2) Transport to Waste Processing/Disposal, (C3) Waste Processing, (C4) Disposal of Waste

D* (D) Reuse-Recovery & Recycling Potential

Optional Items - Proposed Design ONLY

Please break out the following in per element emissions by life cycle in kgCO2e. Leave blank any sections that were not calculated separately from Whole Building GWP

	Upfront Carbon			Use Phase	End of Life	Total
	A1-3	A4	A5	B1-5	C1-4	
Interiors GWP (kgCO2e):						
MEP GWP (kgCO2e):						
Site/Landscaping GWP (kgCO2e):						
FF&E GWP (kgCO2e):						



CALGreen Quick Guide

DIVISION 5.4 - MATERIAL CONSERVATION AND RESOURCE EFFICIENCY

Division 5.4, Section 5.401 – Begins on page 5-13 of CALGreen and on page 39 of the 2022 Guide.

SECTION 5.401
GENERAL

Amended code language.

5.401.1 Scope. The provisions of this chapter specify the requirements of achieving material conservation, resource efficiency, and greenhouse gas (GHG) emission reduction through protection of buildings from exterior moisture, construction waste diversion, employment of techniques to reduce pollution through recycling of materials, the installation of products with lower GHG emissions and building commissioning or testing and adjusting.

Change for 2022 Intervening Cycle Supplement: Section has been amended to include greenhouse gas (GHG) emission reduction and provide clarity.

SECTION 5.409
LIFE CYCLE ASSESSMENT

Section 5.409 – Begins on page 5-15 of CALGreen.

…

New code language added to the formerly reserved section.

5.409.1 Scope.

[BSC-CG] Effective July 1, 2024, projects consisting of newly constructed building(s) with a combined floor area of 100,000 square feet or greater shall comply with either Section 5.409.2, or Section 5.409.3. Alteration(s) to existing building(s) where the combined altered floor area is 100,000 square feet or greater shall comply with either 5.105.2, 5.409.2, or 5.409.3. Addition(s) to existing building(s) where the total floor area combined with the existing building(s) is 100,000 square feet or greater shall comply with either Section 5.105.2, Section 5.409.2, or Section 5.409.3. Effective January 1, 2026, the combined floor area shall be 50,000 square feet or greater.

INTENT:

The intent of Section 5.409 is to add new mandatory regulations for the Whole Building Life Cycle Assessment (WBLCA) and Product Global Warming Potential (GWP) compliance pathways, giving design professionals two additional methods to comply with embodied carbon reduction requirements.

At this time, these regulations do not apply to commercial buildings that are adapted (modernized and repurposed) to be used for residential purposes, as these types of projects are outside the scope of BSC's authority. BSC promulgates *CALGreen* standards for nonresidential occupancies where no other agency has authority to adopt green building standards, state buildings, and University of California and California State University buildings. For example, OSHPD has jurisdiction over hospitals and other health facilities.

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Panel

David P. Wright
Director of Preconstruction,
Schuff Steel

Hafsa Burt, AIA, LEED FELLOW, LFA
Founder & Design
Director, hb+a Architects

James Little
Director of Technical
Sales, NRMCC

Salma Syed, PE
Structural Project
Manager, DCI Engineers

Sophie Pennetier
Assoc. Director Special
Projects, enclos &
Adjunct Faculty, SCI-Arc

Jessie Buckmaster, LFA, LEED AP BD+C
Director of Sustainability,
Hathaway Dinwiddie

Today's Outline

1. Introduction:
   - Buy Clean
   - Design Team and GC Collaboration
2. Approaching Each Material:
   - Steel
   - Concrete
   - Enclosure
     - Glass
     - Insulation
3. Moderated Discussion and Q&A

Goal: Build awareness of GWP limits and impacts of procurement to comply with CALGreen regulations.

Many Contributors!

Introduction

Buy Clean Timeline

- California first adopted legislation in 2017, but adoption has been delayed one year due to Covid-19.
- Notably, concrete was not included in GWP limits. There are current legislation (SB 778) to add limitations.
- Similar legislation was proposed in Washington, but not ratified. Colorado is the only other state to do so.

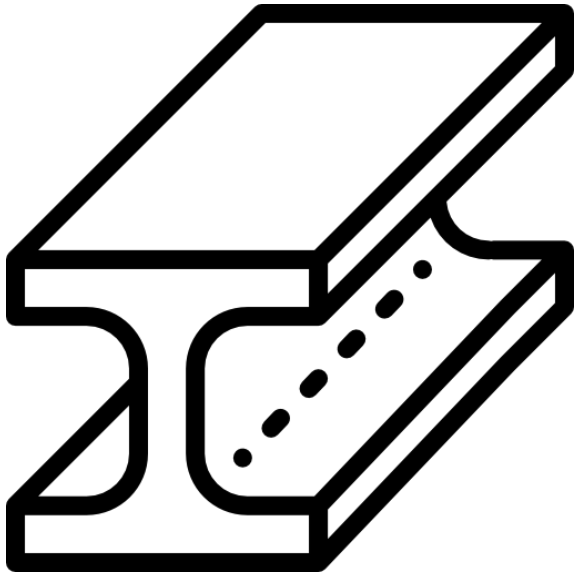
GWP LIMITS

Table 1: GWP limits for eligible materials

Eligible material	Maximum acceptable GWP limit (unfabricated)*
Hot-rolled structural steel sections	1.01 MT CO_2 eq./MT
Hollow structural sections	1.71 MT CO_2 eq./MT
Steel plate	1.49 MT CO_2 eq./MT
Concrete reinforcing steel	0.89 MT CO_2 eq./MT
Flat glass	1.43 MT CO_2 eq./MT
Light-density mineral wool board insulation	3.33 kg CO_2 eq./1 m^2
Heavy-density mineral wool board insulation	8.16 kg CO_2 eq./1 m^2

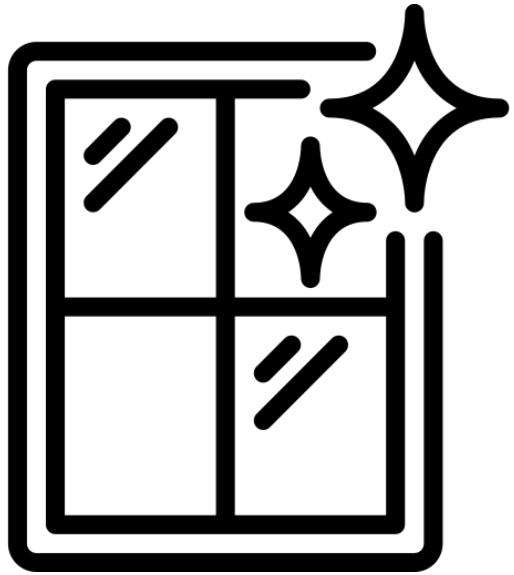
CALGreen Materials List

Ready-Mixed Concrete

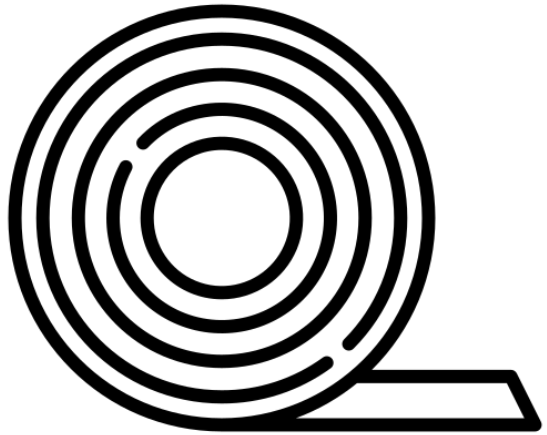


Steel:

- Hot-Rolled Steel
- Hollow Sections
- Steel Plate
- Conc. Reinforcing



Flat Glass



Insulation:

- Light-Density &
- Heavy-Density Mineral Wool Board Insulation

CALGreen GWP Performance Mandatory Limits

Mandatory
175% of IW-EPD GWP Limits

Tier 1
150% of IW-EPD GWP Limits

Tier 2
IW-EPD GWP Limits

TABLE 5.409.3
PRODUCT GWP LIMITS

Buy Clean California Materials Product Category [1]	Maximum acceptable GWP value (unfabricated) ($GWP_{allowed}$)	Unit of Measurement
Hot-rolled structural steel sections	1.77	MT CO_{2e}/MT
Hollow structural sections	3.00	MT CO_{2e}/MT
Steel plate	2.61	MT CO_{2e}/MT
Concrete reinforcing steel	1.56	MT CO_{2e}/MT
Flat glass	2.50	kg CO_{2e}/MT
Light-density mineral wool board insulation	5.83	kg CO_{2e}/1 m^2
Heavy-density mineral wool board insulation	14.28	kg CO_{2e}/1 m^2

Concrete, Ready-Mixed [2, 3]

Concrete Product Category	Maximum GWP allowed value ($GWP_{allowed}$)	Unit of Measurement
up to 2499 psi	450	kg CO_{2e}/m^3
2500-3499 psi	489	kg CO_{2e}/m^3
3500-4499 psi	566	kg CO_{2e}/m^3
4500-5499 psi	661	kg CO_{2e}/m^3
5500-6499 psi	701	kg CO_{2e}/m^3
6500 psi and greater	799	kg CO_{2e}/m^3

Concrete, Lightweight Ready-Mixed [2]

Concrete Product Category	Maximum GWP allowed value ($GWP_{allowed}$)	Unit of Measurement
up to 2499 psi	875	kg CO_{2e}/m^3
2500-3499 psi	956	kg CO_{2e}/m^3
3500-4499 psi	1,039	kg CO_{2e}/m^3

Environmental Product Declarations

ENVIRONMENTAL IMPACTS

Declared Product:
Mix 3EFZ75Q1 • South San Francisco (wet) Plant
3IN LN 0.45 W/C 1" EF45 3-5SL CO2
Compressive strength: 5000 PSI at 28 days

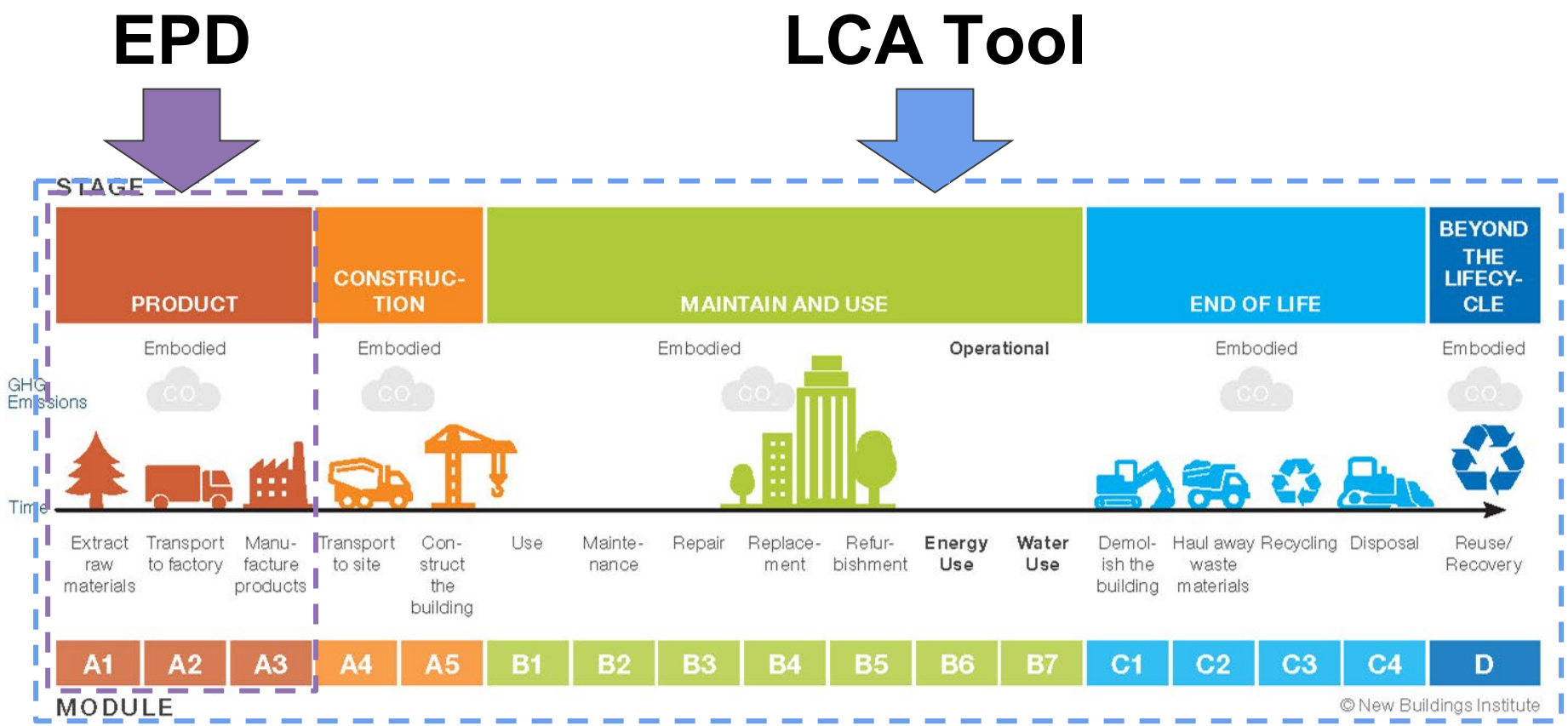
Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	**287**
Ozone Depletion Potential (kg CFC-11-eq)	**1.0E-5**
Acidification Potential (kg SO_2-eq)	**1.86**
Eutrophication Potential (kg N-eq)	**0.36**
Photochemical Ozone Creation Potential (kg O_3-eq)	**40.7**
Abiotic Depletion, non-fossil (kg Sb-eq)	**4.0E-6**
Abiotic Depletion, fossil (MJ)	**817**
Total Waste Disposed (kg)	**1.90**
Consumption of Freshwater (m^3)	**1.86**

Product Components: natural aggregate (ASTM C33), crushed aggregate (ASTM C33), Portland cement (ASTM C150), slag cement (ASTM C989), fly ash (ASTM C618), batch water (ASTM C1602), admixture (ASTM C494)

- EPDs are LCAs of Products
- Third Party Verified
- ISO 14044 & EN 15804
- Avoids Greenwashing
- EPDs can be Industry Average or Manufacturer / Plant / Product Specific

Life Cycle Scope



New Buildings Institute

Environmental Product Declarations (EPDs)

Industry-Average

ENVIRONMENTAL PRODUCT DECLARATION

HOLLOW STRUCTURAL SECTIONS

STEEL TUBE INSTITUTE

STEEL TUBE INSTITUTE

The Steel Tube Institute was formed in 1930 when a group of manufacturers joined forces to promote and market steel tubing. Their goal was to mount a cooperative effort that would improve manufacturing techniques and inform customers about their products' utility and versatility. This remains the basic motivation for the Institute's efforts today. Using that strong history as a foundation, STI is constantly evolving to best meet the needs of a sophisticated and competitive marketplace. The organization is dedicated to the betterment of the steel industry and to the advancement of its member companies.

For more information, please visit: www.steeltubeinstitute.org

CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION

Hollow Structural Sections produced in North America by the Steel Tube Institute members.

Use of this EPD is limited to STI members. Member names are available online at www.steeltubeinstitute.org/about-us/sti-producers/

Product-Specific / Factory-Specific

ENVIRONMENTAL PRODUCT DECLARATION

Page 1

Atlas Tube — A DIVISION OF ZEKELMAN INDUSTRIES ← Producer

CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION

According to ISO 14025 and ISO 21930:2017

ATLAS TUBE
HOLLOW STRUCTURAL SECTIONS

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Environment 333 Pfingsten Road Northbrook, Il 60611	https://www.ul.com https://spot.ul.com
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	General Program Instructions v.2.5 March 2020	
ASSOCIATION NAME AND ADDRESS	Atlas Tube, 1855 East 122nd Street, Chicago, Illinois 60633 |	
DECLARATION NUMBER	4790050508.101.1	
DECLARED PRODUCT & DECLARED UNIT	Hollow structural steel sections, 1 metric ton	
REFERENCE PCR AND VERSION NUMBER	Part A: Calculation Rules for the LCA and Requirements Project Report, (IBU/UL Environment, V3.2, 12.12.2018) and Part B: Designated Steel Construction Product EPD Requirements (UL Environment, V2.0, 08.26.2020).	
DESCRIPTION OF PRODUCT APPLICATION/USE	Hollow structural steel sections used in construction	← Confirm PCR approval by Buy Clean
MARKETS OF APPLICABILITY	North America	
DATE OF ISSUE	March 22, 2022	← Validity of EPD
PERIOD OF VALIDITY	5 years	
EPD TYPE	Product specific	
EPD SCOPE	Cradle to gate	
YEAR(S) OF REPORTED PRIMARY DATA	2019-2020	
LCA SOFTWARE & VERSION NUMBER	GaBi v10	
LCI DATABASE(S) & VERSION NUMBER	GaBi 2021 (CUP 2021.2)	
LCIA METHODOLOGY & VERSION NUMBER	IPCC AR5 + TRACI 2.1	

The sub-category PCR review was conducted by: UL Environment, PCR Review Panel, epd@ul.com ← Certification of EPD

This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report,", v3.2 (December 2018), in conformance with ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017)

☐ INTERNAL ☒EXTERNAL

CooperMcC

Cooper McCollum, UL Environment

Required for Prescriptive Path

Steel Tube Institute

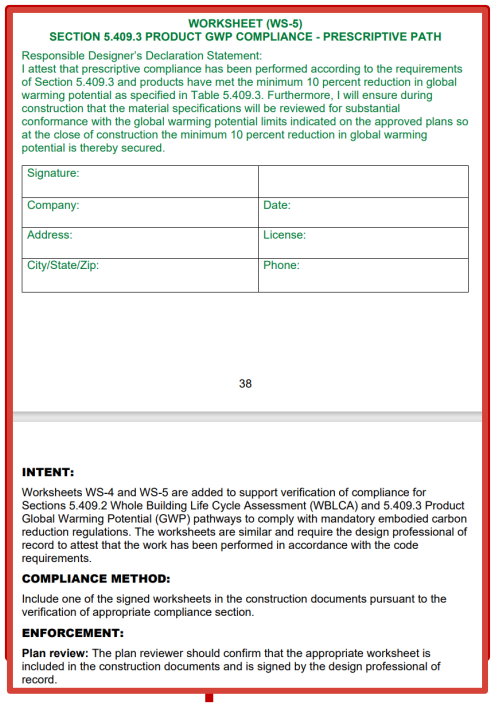
Reporting Template Submitted at Permitting

Understand overall impact to inform system selection

EPDs and procurement document

***Prescriptive Requirements**

In Drawing or Specs:



WORKSHEET (WS-5)
SECTION 5.409.3 PRODUCT GWP COMPLIANCE - PRESCRIPTIVE PATH

Responsible Designer's Declaration Statement:
I attest that prescriptive compliance has been performed according to the requirements of Section 5.409.3 and products have met the minimum 10 percent reduction in global warming potential as specified in Table 5.409.3. Furthermore, I will ensure during construction that the material specifications will be reviewed for substantial conformance with the global warming potential limits indicated on the approved plans so at the close of construction the minimum 10 percent reduction in global warming potential is thereby secured.

Signature:	
Company:	Date:
Address:	License:
City/State/Zip:	Phone:

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INTENT:

Worksheets WS-4 and WS-5 are added to support verification of compliance for Sections 5.409.2 Whole Building Life Cycle Assessment (WBLCA) and 5.409.3 Product Global Warming Potential (GWP) pathways to comply with mandatory embodied carbon reduction regulations. The worksheets are similar and require the design professional of record to attest that the work has been performed in accordance with the code requirements.

COMPLIANCE METHOD:

Include one of the signed worksheets in the construction documents pursuant to the verification of appropriate compliance section.

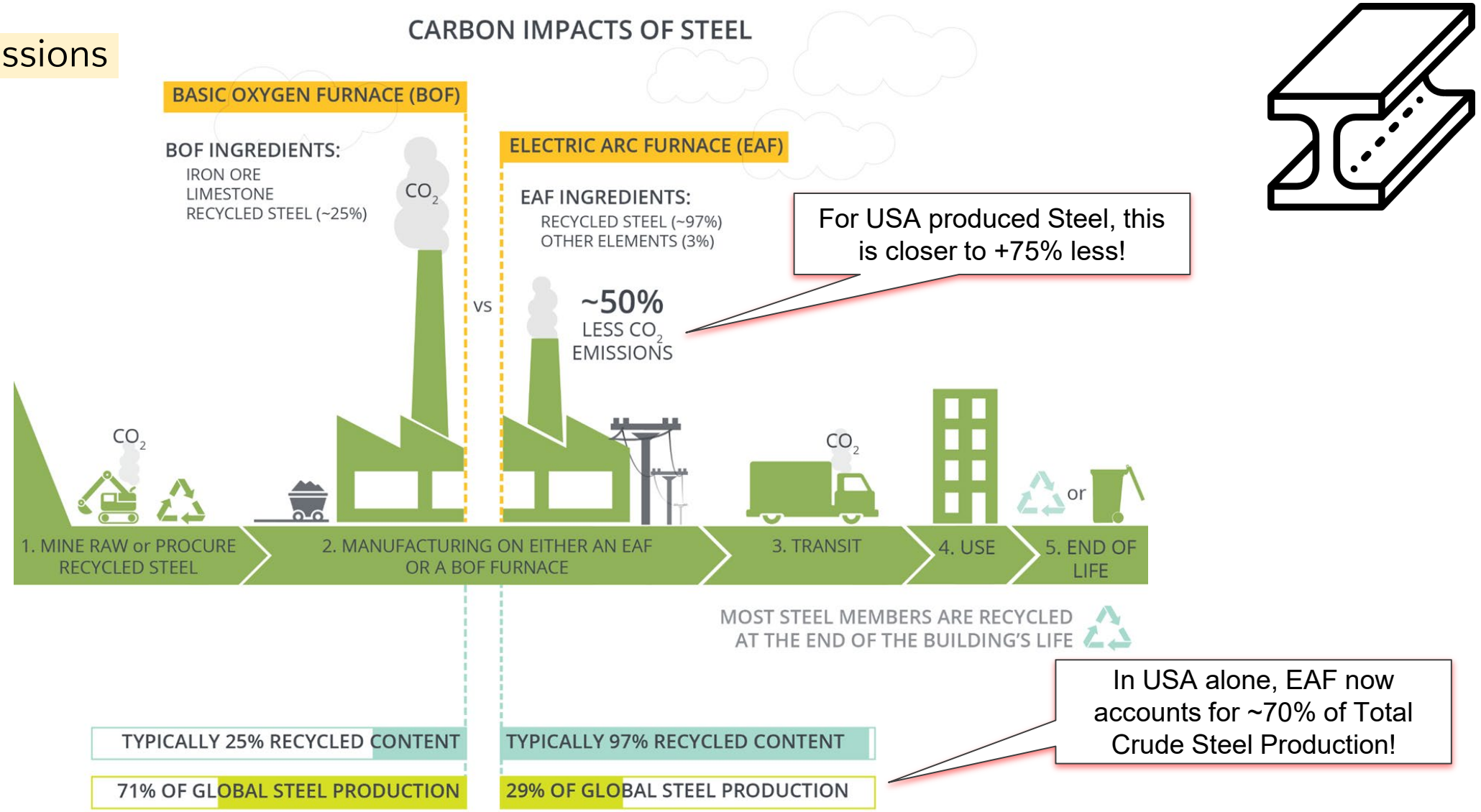
ENFORCEMENT:

Plan review: The plan reviewer should confirm that the appropriate worksheet is included in the construction documents and is signed by the design professional of record.

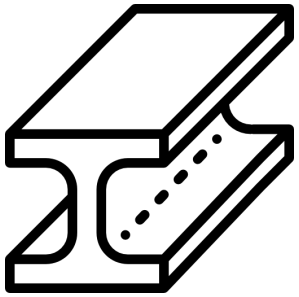
Concept → SD → DD → CD → Permitting → CA

Steel

Where do emissions come from?



Architecture 2030



When Specifying Materials, consider discussing with General Contractor, Local Steel Fabricators & Suppliers:

- What Types of Materials and Quantities
- Mandatory vs. Tier 1 and Tier 2
- Reported as "Fabricated" vs. "Unfabricated"

Helpful resources for Designers and Contractors:

- AISC Sustainability Website (https://www.aisc.org/why-steel/sustainability)
  - Links to EPD's (Industry Average / Facility Specific)
  - Guide towards writing Specifications
  - Extensive List of North American Mills whom have published EPD's
- Code of Standard Practice (AISC 303-22)
- Carbon Leadership Forum – Architects Toolkit

Example Specification Language
SECTION 05 12 00:
"Contractors are required to procure all **hot-rolled-section steel** that does not exceed a cradle-to-mill gate GWP of **1.77 kgCO2e/kg** of steel as disclosed in mill-specific, Type III EPDs."

TABLE 5.409.3
PRODUCT GWP LIMITS

Buy Clean California Materials Product Category [1]	Maximum acceptable GWP value (unfabricated) ($GWP_{allowed}$)	Unit of Measurement
Hot-rolled structural steel sections	1.77	MT CO_{2e}/MT
Hollow structural sections	3.00	MT CO_{2e}/MT
Steel plate	2.61	MT CO_{2e}/MT

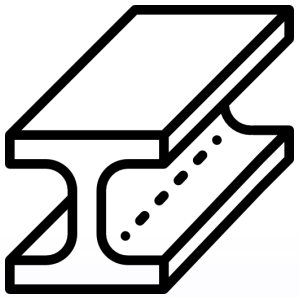
UCSD Triton Center – San Diego CA

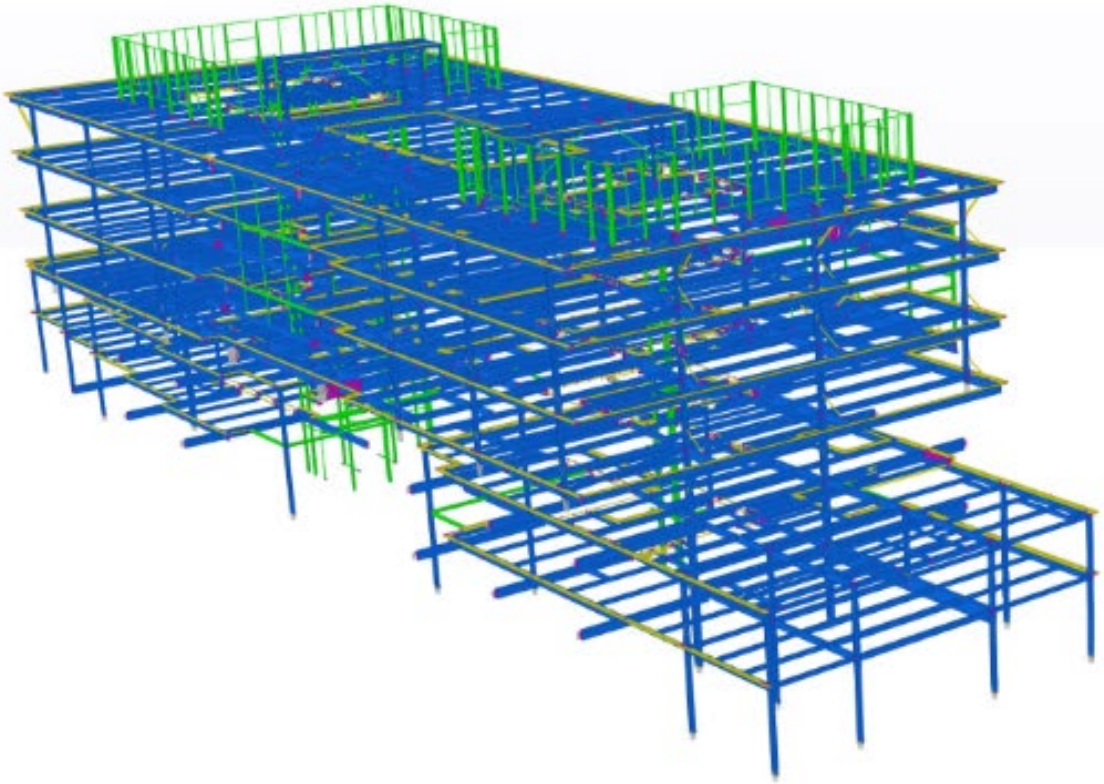
- Awarded Fall of 2023
- All structural steel required to meet BCCA
- Approx 305,000 SF in new structures
- 1400 Tons of new Structural Steel
- Lateral Systems ; Concrete Shear Walls & BRB's + RBS
- Start of Erection July 2024

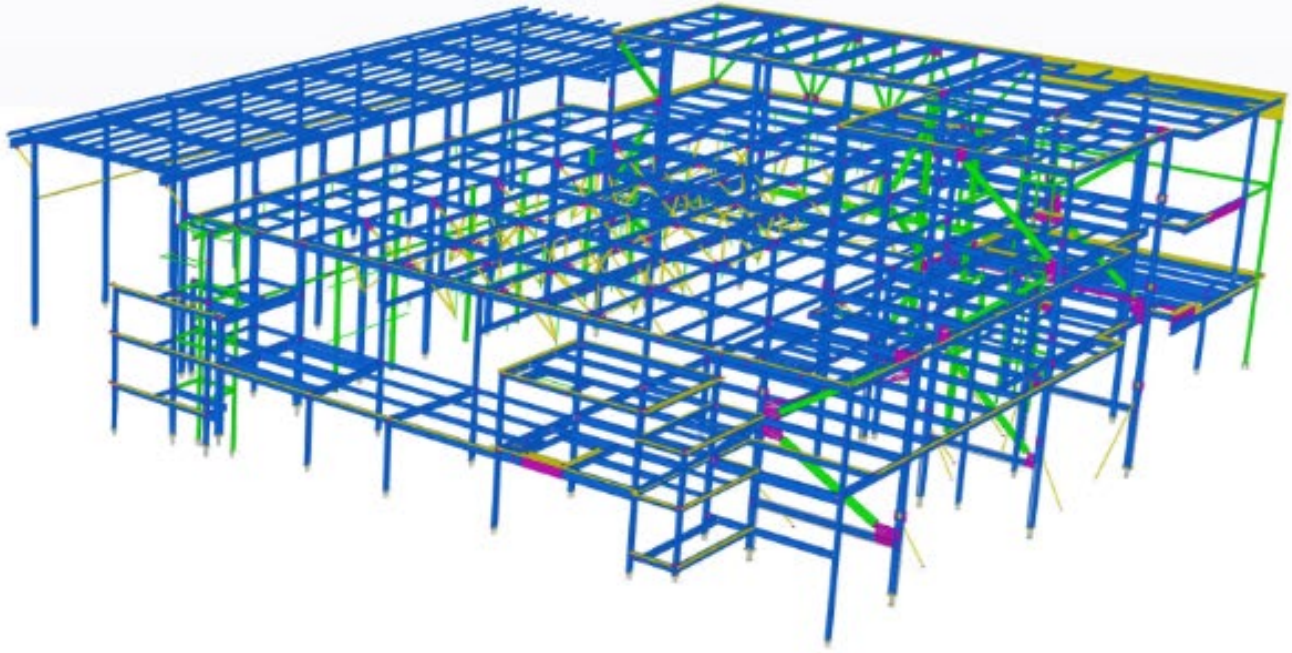
Steel Procurement Strategies:

- Mill Orders – Direct Procurement from Mill
- Smaller Orders – Service Centers & WH

UCSD Triton Center – San Diego CA







Concrete

Product Specific Example

NATIONAL CEMENT
The National Cement Company, Inc.

Environmental Product Declaration (EPD) for Cement Produced at Lebec, California Operation

GENERAL INFORMATION

This cradle to gate Environmental Product Declaration covers cement products produced at the Lebec Production Plant. The Life Cycle Assessment (LCA) was prepared in conformity with ISO 21930, ISO 14025, ISO 14040, and ISO 14044. This EPD is intended for business-to-business (B-to-B) audiences.

NATIONAL CEMENT COMPANY OF CALIFORNIA

Lebec Operation

33503 CA-138
Lebec, CA 93243

PROGRAM OPERATOR

ASTM International
100 Barr Harbor

West Conshohocken, PA 19428
https://www.astm.com
610-832-9500

EPD 603
December 12, 2023
Valid for 5 years

ENVIRONMENTAL IMPACTS Lebec Plant:
Product-Specific Type III EPD Declared Cement
Product:
Type IL, Type IL Block and Type II/V
Declared Unit: One metric Ton of cement

IMPACT CATEGORIES	Type IL	Type IL Block	Type II/V
Global Warming Potential, kg CO_2 eq	698	650	748
Ozone Depletion Potential kg CFC-11 eq	4.32E-05	4.10E-05	4.64E-05
Eutrophication Potential kg N eq	2.72E-01	2.50E-01	2.87E-01
Acidification Potential kg SO_2 eq	1.24	1.07	1.32
Photochemical Ozone Formation Potential, kg O_3eq	25.2	21.2	26.8
Abiotic Depletion, non-fossil kg Sb eq	1.21E-05	1.06E-05	1.29E-05
Abiotic Depletion, fossil MJ, NCV	4,739	4,353	5,047
PRODUCT COMPONENTS			
Clinker Percent	84%	79%	90%
Limestone, Gypsum and others percent	16%	21%	10%

NATIONAL READY MIX

ENVIRONMENTAL PRODUCT DECLARATION
Mix O60C649Q10 • Vernon Plant

NATIONAL READY MIXED CONCRETE COMPANY

This Environmental Product Declaration (EPD) reports the impacts for 1 m^3 of ready mixed concrete mix, for use in business-to-business (B2B) comunication 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

National Ready Mix
15821 Ventura Boulevard, Suite 475
Encino, CA 91436

PLANT

Vernon Plant
2626 26th Street
Vernon, CA 90058

EPD PROGRAM OPERATOR

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428

DATE OF ISSUE

11/21/2023 **(valid for 5 years until 11/21/2028)**
(Portable plant validity is limited to location specified)

ENVIRONMENTAL IMPACTS

Declared Product:
Mix O60C649Q10 • Vernon Plant
Description: 1 5000PSI PU PL
Compressive strength: 5000 PSI at 28 days

Declared Unit: 1 m^3 of concrete (1 cyd)

Global Warming Potential (kg CO_2-eq)	198 (152)
Ozone Depletion Potential (kg CFC-11-eq)	8.46E-6 (6.47E-6)
Acidification Potential (kg SO_2-eq)	2.44 (1.87)
Eutrophication Potential (kg N-eq)	0.18 (0.14)
Photochemical Ozone Creation Potential (kg O_3-eq)	54.0 (41.3)
Abiotic Depletion, non-fossil (kg Sb-eq)	4.94E-6 (3.77E-6)
Abiotic Depletion, fossil (MJ)	1,607 (1,228)
Total Waste Disposed (kg)	0.17 (0.13)
Consumption of Freshwater (m^3)	0.79 (0.60)

Product Components: natural aggregate (ASTM C33), slag cement (ASTM C989), 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

ISO 21930:2017 Sustainability in Building Construction — Environmental Declaration of Building Products: serves as the core PCR
PCR for Concrete, NSF International, December 2022 v2.2 serves as the sub-category PCR

Sub-category PCR review was conducted by Thomas P. Gloria • Industrial Ecology Consultants

Independent verification of the declaration, according to ISO 14025:2006: ☐ internal ☑ external

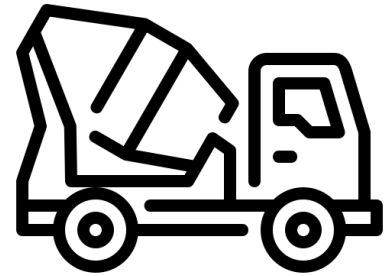
Third party verifier Thomas P. Gloria (t.gloria@industrial-ecology.com) • Industrial Ecology Consultants

climate earth
EPDs made easy

For additional explanatory material
Manufacture Representative: John Halverson (JHalverson@natcem.com)
Software Tool: CarbonCLARITY Suite, EPD Generator • Verification
LCA & EPD Developer: Climate Earth (support@climateearth.com)

NATIONAL READY MIX
15821 Ventura Boulevard, Suite 475
Encino, CA 91436
(818) 728-5200

VERNON
2626 26th Street
Vernon, CA 90058
909-657-4000



Where do emissions come from?

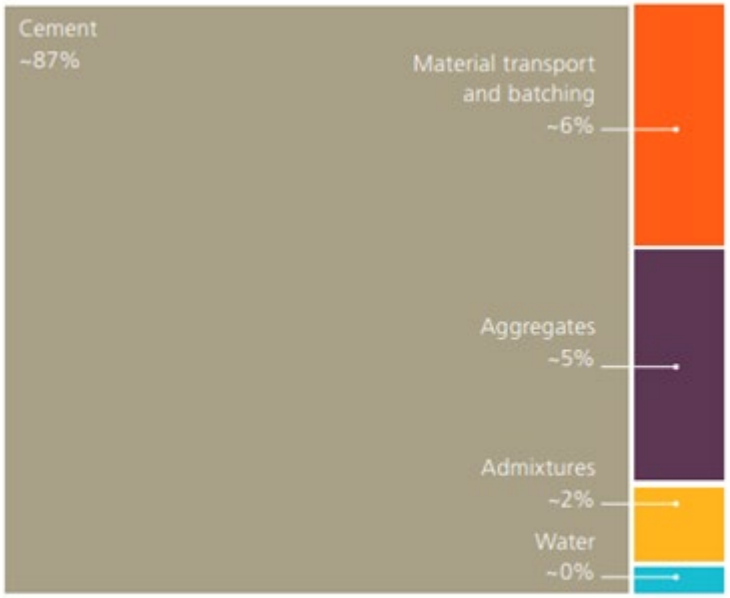
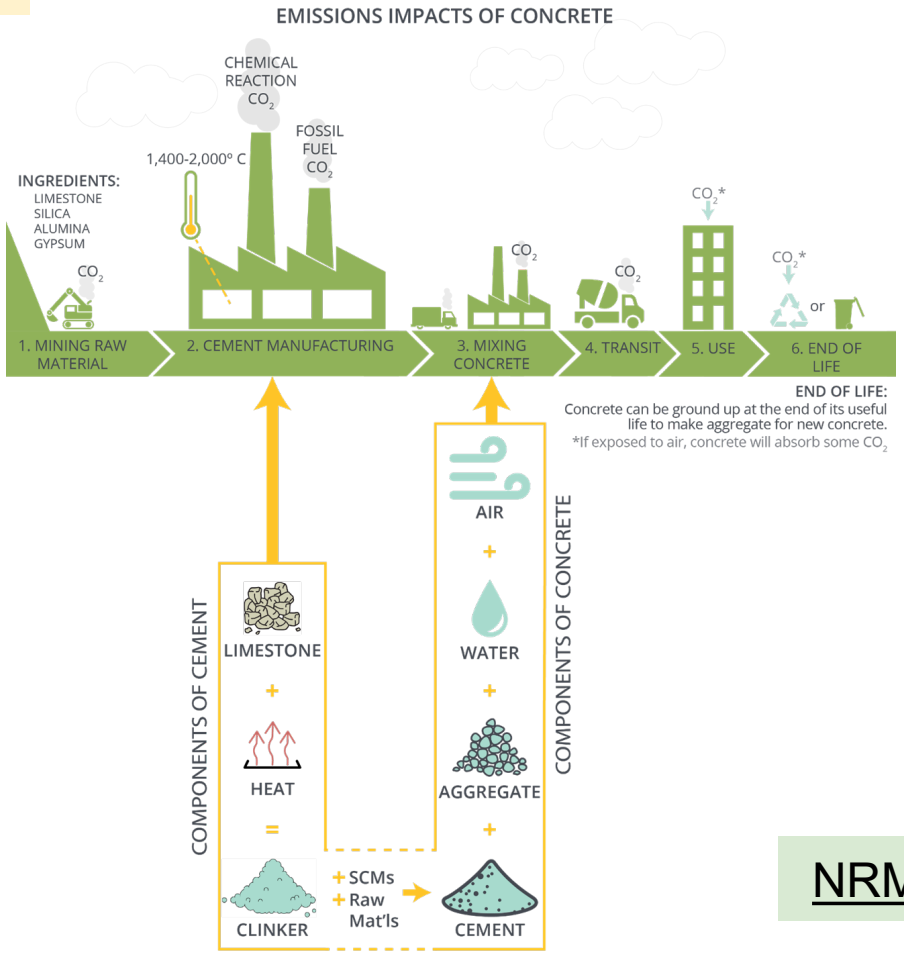
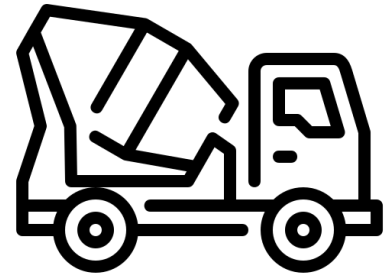


Fig 1.1: Distribution of embodied carbon in a typical structural concrete (RC25/30), LCA stages A1 to A3

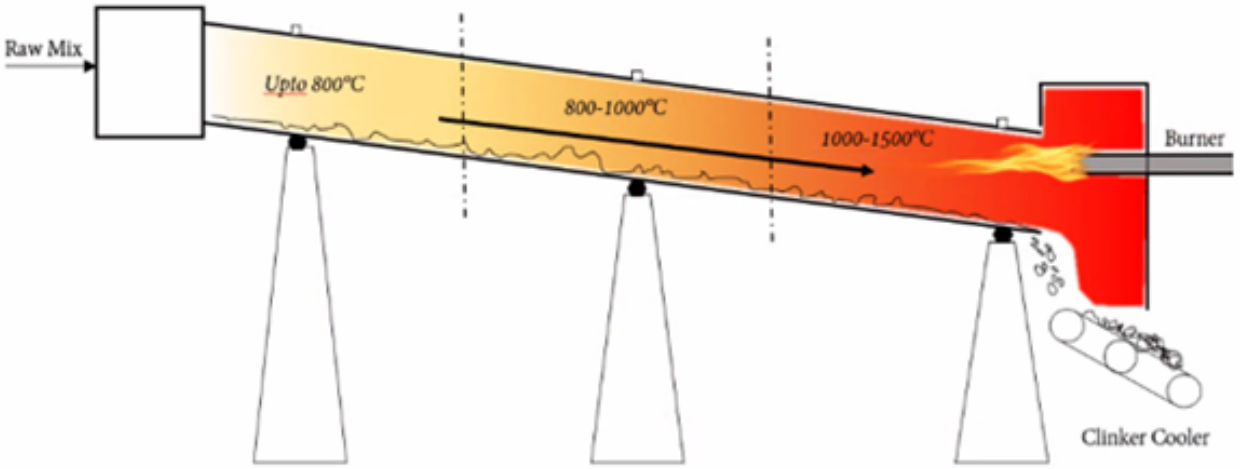


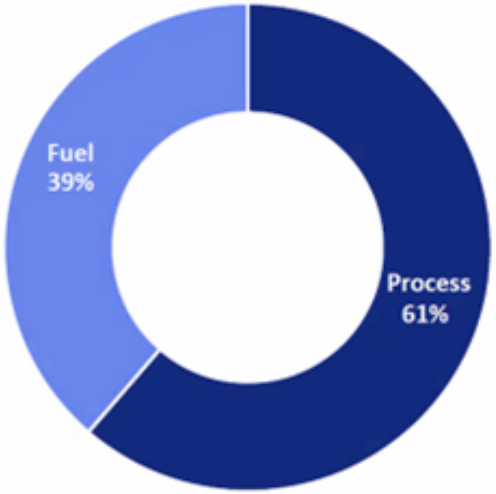
NRMCA & ClimateEarth EPD Tool

Where do emissions come from?



Cement Manufacturing – 2 Main CO_2 Sources:





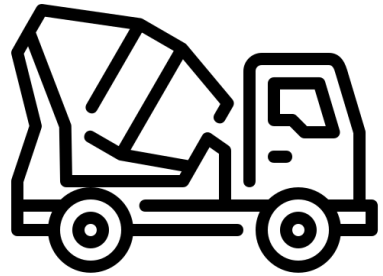
Fuel: California plants use advanced and energy efficient production technology
Process: PLC helps reduce these emissions

1. Thermal energy related: peak temperatures of 1400–1450 °C (2550 – 2650 °F) are required for calcining reaction: +/- 39% of CO_2 emissions
2. Material related (process) emissions: ($CaCO_3$ -> $CaO + CO_2$): +/- 61% of CO_2 emissions

Concrete

INTENT:

The intent of these mandatory requirements is to encourage the use of products and materials for which life-cycle information is available (in the form of EPD) and that have lower GWP impacts.



Concrete, being a unique regional product, is allowed a weighted average calculation for all concrete mixes used on a project as various regions in California may not be able to comply with prescriptive maximum acceptable GWP values in Table 5.409.3.

Project teams can choose for each mix to comply with the GWP value in the table, or they can use exception equation 5.409.3.1 to illustrate that, collectively, the concrete mixes do not exceed the allowed GWP value. The weighted average approach also allows more flexibility by allowing projects the ability to trade-off concrete mixes: high performance/high GWP concrete can be offset with low GWP concrete (flatwork, for example).

Concrete

New code language: sections and table.

5.409.3 Product GWP compliance – prescriptive path. Each product that is permanently installed and listed in Table 5.409.3 shall have a Type III environmental product declaration (EPD), either product-specific or factory-specific.

5.409.3.1 Products shall not exceed the maximum GWP value specified in Table 5.409.3.

Exception: Concrete may be considered one product category to meet compliance with this section. A weighted average of the maximum GWP for all concrete mixes installed in the project shall be less than the weighted average maximum GWP allowed per Table 5.409.3 using Exception Equation 5.409.3.1. Calculations shall be performed with consistent units of measurement for the material quantity and the GWP value. For the purposes of this exception, industry wide EPD's are acceptable.

Exception EQUATION 5.409.3.1

$GWP_n < GWP_{allowed}$

where

$GWP_n = \Sigma\,(GWP_n)(v_n)$ *and* $GWP_{allowed} = \Sigma\,(GWP_{allowed})(v_n)$

and

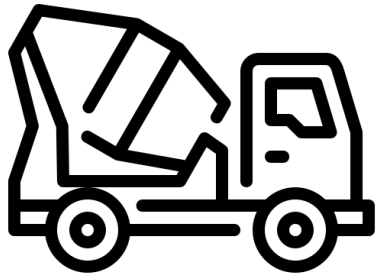
n = each concrete mix installed in the project

GWP_n = the GWP for concrete mix n per concrete mix EPD, in kg CO_{2e} /m^3

$GWP_{allowed}$ = the GWP potential allowed for concrete mix n per Table 5.409.3

v_n = the volume of concrete mix n installed in the project, in m^3

5.409.3.2. Verification of compliance. Calculations to demonstrate compliance, Type III EPDs for products required to comply if included in the project, and Worksheet WS-5 signed by the design professional of record shall be provided on the construction documents. Updated EPDs for products used in construction shall be provided to the owner at the close of construction and to the enforcement entity upon request. The enforcing agency may require inspection and inspection reports in accordance with Sections 702.2 and 703.1 during and at completion of construction to demonstrate substantial conformance. Inspection shall be performed by the design professional of record or third party acceptable to the enforcing agency.

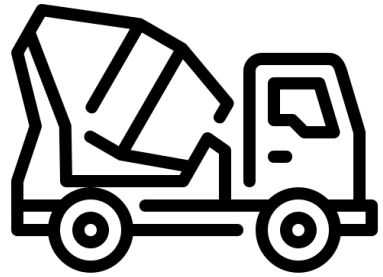


Concrete

TABLE 5.409.3
PRODUCT GWP LIMITS

Concrete, Ready-Mixed [2, 3]

Concrete Product Category	Maximum GWP allowed value ($GWP_{allowed}$)	Unit of Measurement
up to 2499 psi	450	kg CO_{2e}/m^3
2500-3499 psi	489	kg CO_{2e}/m^3
3500-4499 psi	566	kg CO_{2e}/m^3
4500-5499 psi	661	kg CO_{2e}/m^3
5500-6499 psi	701	kg CO_{2e}/m^3
6500 psi and greater	799	kg CO_{2e}/m^3

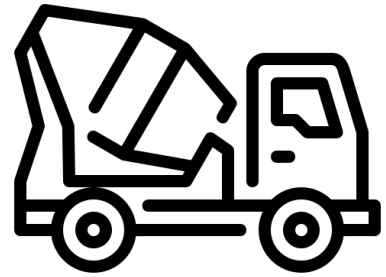


Concrete, Lightweight Ready-Mixed [2]

Concrete Product Category	Maximum GWP allowed value ($GWP_{allowed}$)	Unit of Measurement
up to 2499 psi	875	kg CO_{2e}/m^3
2500-3499 psi	956	kg CO_{2e}/m^3
3500-4499 psi	1,039	kg CO_{2e}/m^3

Footnotes:

1. The GWP values of the products listed in Table 5.409.3 are based on 175 percent of Buy Clean California Act (BCCA) GWP values, except for concrete products which are not included in BCCA.
2. For concrete, 175 percent of the National Ready Mix Concrete Association (NRMCA) 2022 version 3 Pacific Southwest regional benchmark values are used for the GWP allowed, except for High Early strength.
3. Concrete High Early Strength ready-mixed shall be calculated at 130 percent of the Ready mixed concrete GWP allowed values for each product category.

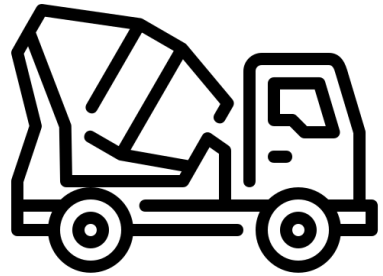


CLF Carbon Leadership Forum Los Angeles | Carbon Leadership Forum Seattle

Structural Component	Specified Strength (psi)	Design Strength	Durability Criteria F	S	W	C	Max. W/C	Limits on SCM(%)	Recommended SCM % Min.	Max.	GWP Baseline (kgCO2e/CY) (Choose one) Option 1	Option 2	Option 3	GWP Target (kgCO2e/CY) 10%	Comments
Mat Foundation Footings Piles, etc.	*Project specific*	@ 56 days	0	0	0	0	N/A	No limit	40%	70%	Specific to local data (ref. EC3, local Buy Clean initiatives)	NRMCA regional data	GSA National Limits (Conservative)		(e.g. exterior)
Mat Foundation Footings Piles, etc.	*Project specific*	@ 56 days	3	0	1	2	0.4	ACI 318-19: 26.4.2.2(b)							(e.g. exterior)
Slab on Grade	2500	@ 56 days	0	0	0	0	N/A	No limit	40%	70%					
Slab on Grade	4500	@ 56 days	2	0	1	2	0.45	No limit	40%	70%					*Severity of freeze thaw exposure class based on project region*
Retaining walls	*Project specific*	@ 56 days	1	0	0	0	0.55	No limit	25%	50%					*- GC sequencing (backfill, shoring, etc)* *- Severity of freeze thaw exposure class should be adjusted based on project region.*
Columns and Walls	*Project specific*	@ 56 days	0	0	0	0	N/A	No limit	35%	50%					(e.g. architecturally exposed)
Slab on metal deck	*3000*	@ 28 days	0	0	0	0	N/A	No limit	15%	50%					
Conventional Slabs	*Project specific*	@ 28 days	0	0	0	0	N/A	No limit	15%	50%					*Work with GC on schedule to see if increased replacement is possible in the summer or if the slabs go off critical path*
PT Slabs	*3000* *5000*	@ 3 days @ 28 days	0	0	0	0	N/A	No limit	15%	50%					
														See concrete budget tab	

Sample Table

NATIONAL
Ready Mixed Concrete Company



CONCRETE PROJECT GWP CALCULATOR

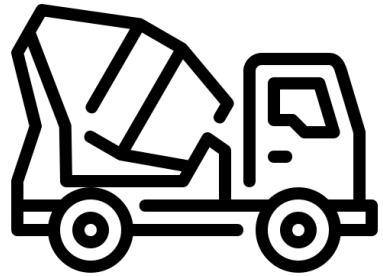
Project: BeWell Campus, Irvine CA
Ready Mix Supplier: National Ready Mixed Concrete Company
Contractor: Oltmans Construction
1-Apr-24

Application Strength-psi	Volume Cubic Yard	Volume Cubic Meter	Mix Design Number	***Submitted Concrete Mix Designs*** GWP kg CO_2e/m^3	Project Total GWP kg CO_2e	CALGreen Nonresidential Max GWP allowed value	CALGreen Nonresidential Project Total GWP kg CO_2e	CLF/PSW Regional Mix GWP kg $CO2e/m^3$	CLF/PSW Regional Mix GWP kg CO2e/m3
Foundations - 4,000 psi	841	643		222	142,734	566	363,907	323	207,671
Slab On Grade- 3,000 psi	855	654		314	205,245	489	319,634	279	182,368
Slab on Metal Deck - 3,000 psi	20	15		481	7,354	956	14,617	500	7,645
Backfill - 200 psi	50	38		131	5,007	450	17,201	174	6,651
Other Structural - 4,000 psi		0		324	0	566	0	323	0
		0			0		0		0
Total	1,766	1,350			360,341		715,359		404,335
This reduction is to CALGreen Nonresidential allowed value						-355,018 kg CO2 eq			-66.0%
Carbon Leadership Forum PSW Benchmark Comparison						-43,994 kg CO2 eq			-11.5%

Product Specific Type III EPD's
The baseline used to calculate this reduction is based on CALGreen Nonresidential and NRMCA V3.2 Pacific SW and Includes life cycle stages A1 through A3

NRMCA Tool

NATIONAL
Ready Mixed Concrete Company



CONCRETE PROJECT GWP CALCULATOR

Project: Weingart Tower - 600 San Pedro, Los Angeles 1-Apr-24
Ready Mix Supplier: National Ready Mixed Concrete Company
Contractor: Pankow Builders

Application Strength-psi	Volume Cubic Yard	Volume Cubic Meter	Mix Design Number	***Submitted Concrete Mix Designs*** GWP kg CO_2e/m^3	Project Total GWP kg CO_2e	CALGreen Nonresidential Max GWP allowed value	CALGreen Nonresidential Project Total GWP kg CO2e	CLF/PSW Regional Mix GWP kg $CO2e/m^3$	CLF/PSW Regional Mix GWP kg $CO2e/m^3$
Mat Foundation - 5,000 psi	2,748	2,101		198	415,968	661	1,388,659	378	794,120
PT Deck - 6,000 psi	2,276	1,740		346	602,041	701	1,219,741	401	697,741
Shear Walls - 10,000 psi	1,576	1,205		478	575,919	799	962,677	456	549,413
Tower Columns - 8,000 psi	21	16		285	4,576	799	12,828	456	7,321
Miscellanous Concrete - 3,500 psi		0		198	0	566	0	301	0
Tower Crane Foundation - 5,000	207	158		415	65,674	661	104,604	378	59,819
Pump Prime	23	18		413	7,262	701	12,326	401	7,051
Rat Slab - 2,000 psi	240	183		270	49,540	450	82,566	257	47,154
Total	7,091	5,421			1,720,979		3,783,401		2,162,618
This reduction is to CALGreen Nonresidential allowed value						-2,062,422 kg CO2 eq			-74.9%
Carbon Leadership Forum PSW Benchmark Comparison						-441,639 kg CO2 eq			-22.7%

Product Specific Type III EPD's
No additional allowance given for required high early strength concrete.

Enclosure

Adobe North Tower

FACADES EMBODIED CARBON - EXAMPLE

Project Example: San Mateo COB3 *(Steel building. Ratios are project-specific!)*

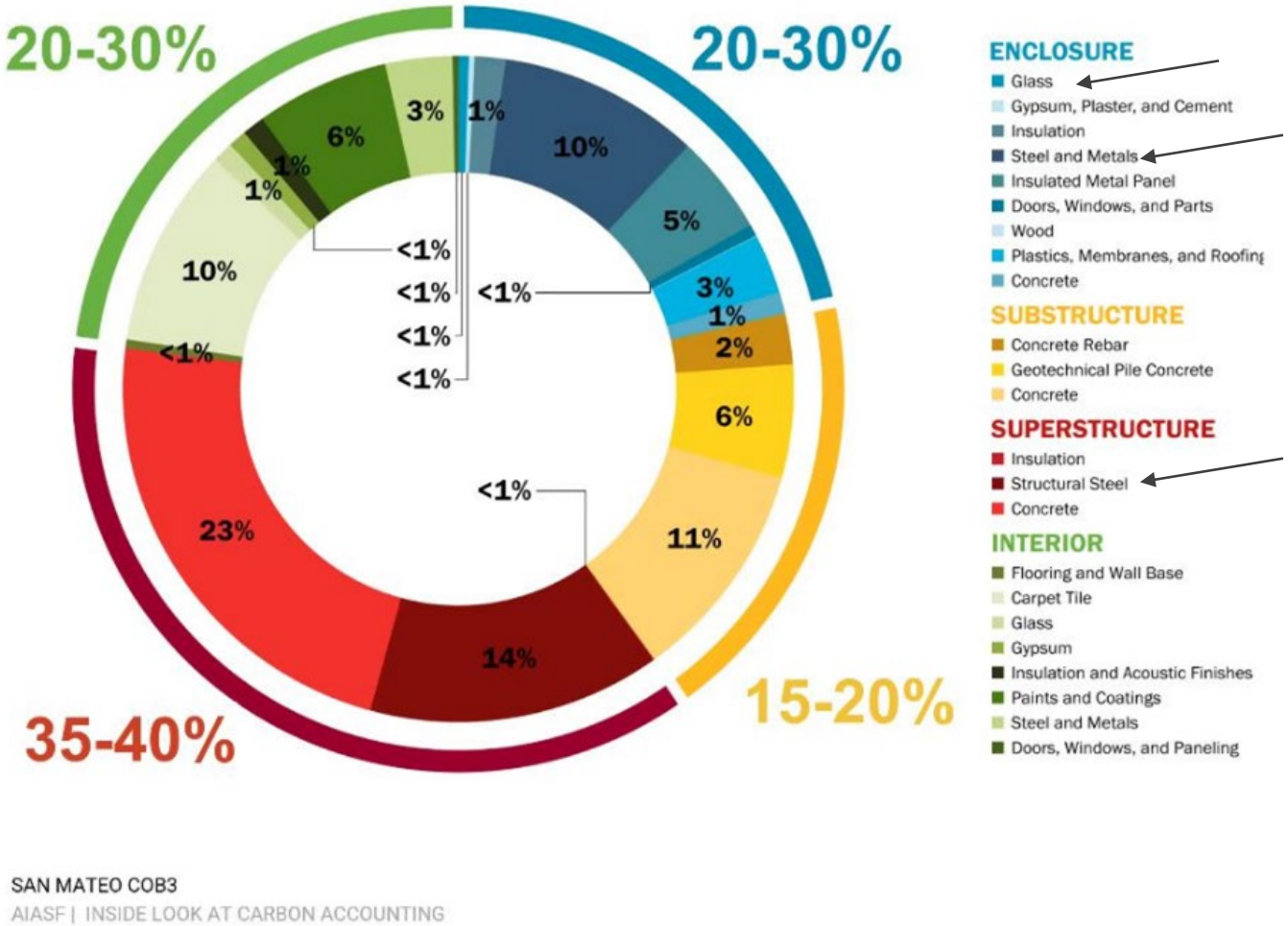
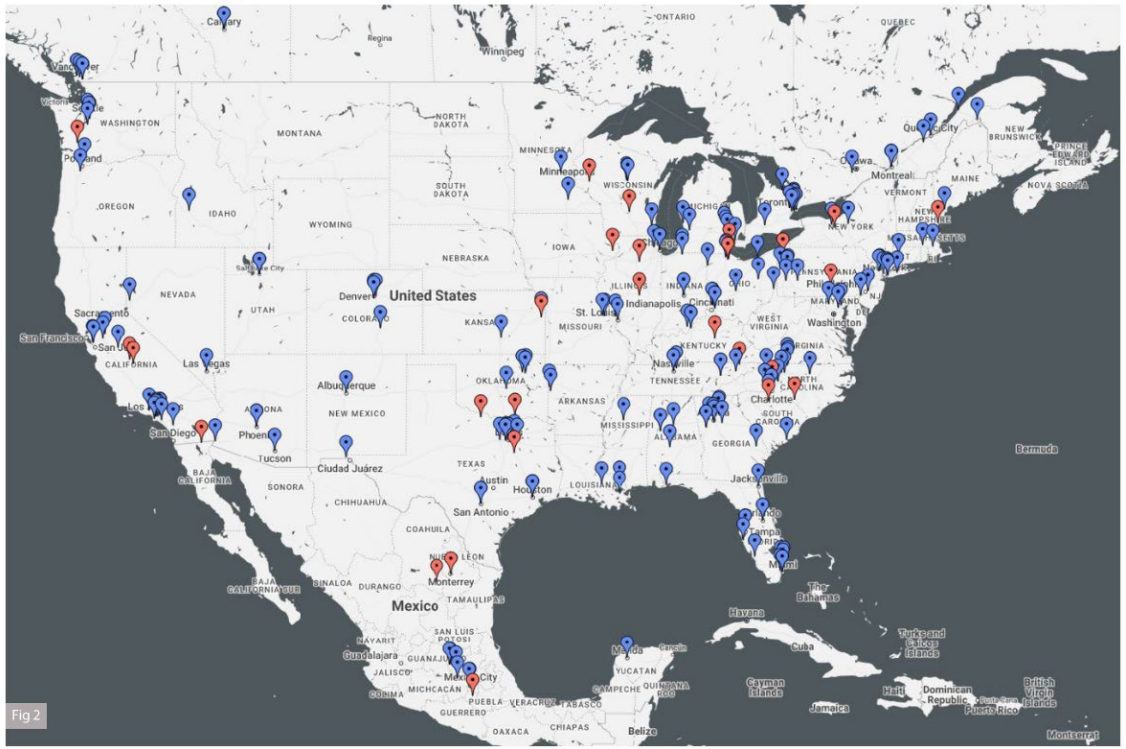


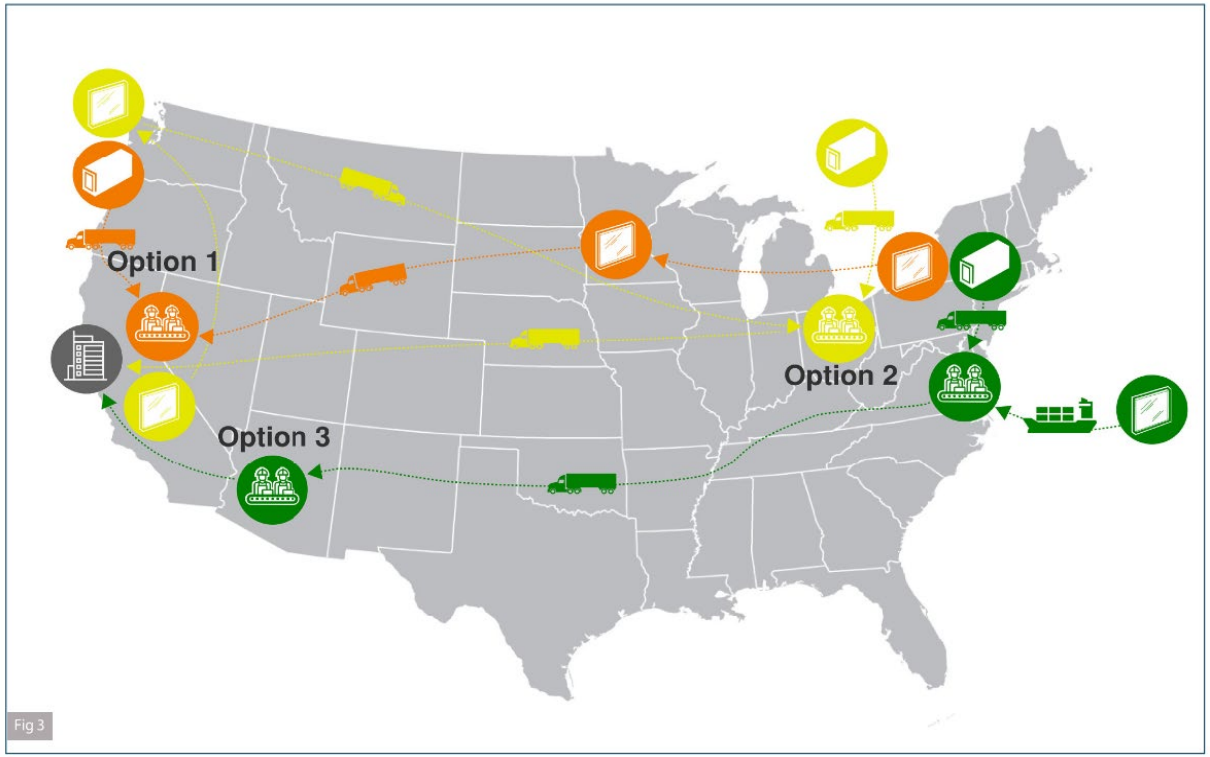
Image courtesy of Atelier Ten

FACADES PROCUREMENT & IMPACTS

Adapted from Karnath & Pennetier IGS 2022



https://worldglassmap.com



https://issuu.com/intelligentpublications/docs/igs_spring2022_hi-res

DYNAMIC SUPPLY CHAIN OF FACADES
Driven primarily by:

- **Schedule**
- **Budget**
- **Warranties**
- **Materials Specifications**

***ADAPTED* FROM HENS & PENNETIER (including updated information):**
TRANSPORTATION ACCOUNTS FOR 5-10% OF SOME CURTAIN WALL BENCHMARKS (CONTEXTUAL TO PROJECT!) WHIST GLASS AND ALUMINUM MATERIAL **PRODUCTION ACCOUNT FOR 75-90%** OF EMBODIED CARBON

Glass

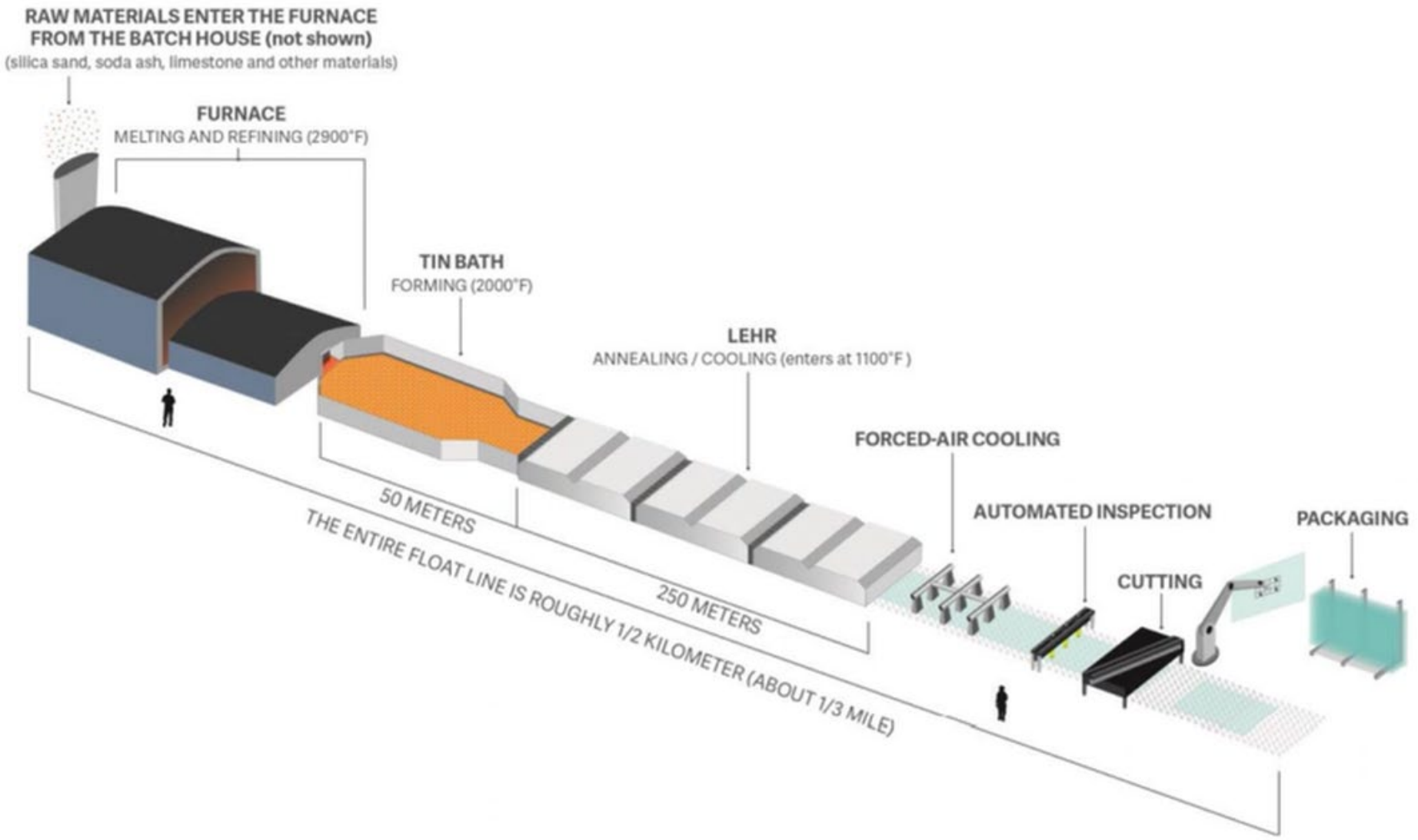


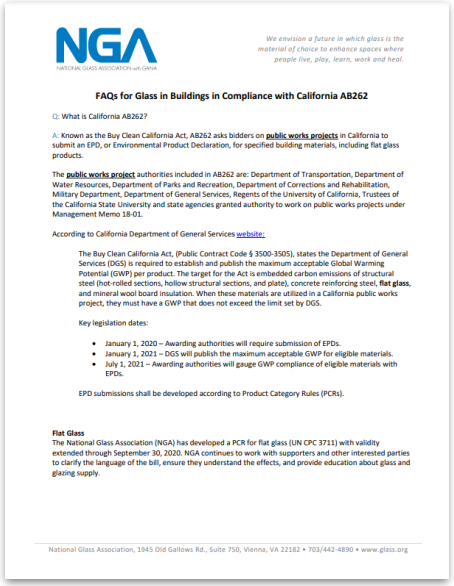
Figure 1: Flat glass production

CALGreen / BCCA GWP Performance
Flat Glass Definition & Mandatory Limits

Definition

Float or rolled glass that is clear or tinted either installed by itself or as a part of a window assembly. Processed glass (e.g., tempered, coated, or laminated) is out of scope of the BCCA.

https://www.dgs.ca.gov/PD/Resources/Page-Content/Procurement-Division-Resources-List-Folder/



NGA

NATIONAL GLASS ASSOCIATION with GANA

We envision a future in which glass is the material of choice to enhance spaces where people live, play, learn, work and heal.

FAQs for Glass in Buildings in Compliance with California AB262

Q: What is California AB262?

A: Known as the Buy Clean California Act, AB262 asks bidders on **public works projects** in California to submit an EPD, or Environmental Product Declaration, for specified building materials, including flat glass products.

The **public works project** authorities included in AB262 are: Department of Transportation, Department of Water Resources, Department of Parks and Recreation, Department of Corrections and Rehabilitation, Military Department, Department of General Services, Regents of the University of California, Trustees of the California State University and state agencies granted authority to work on public works projects under Management Memo 18-01.

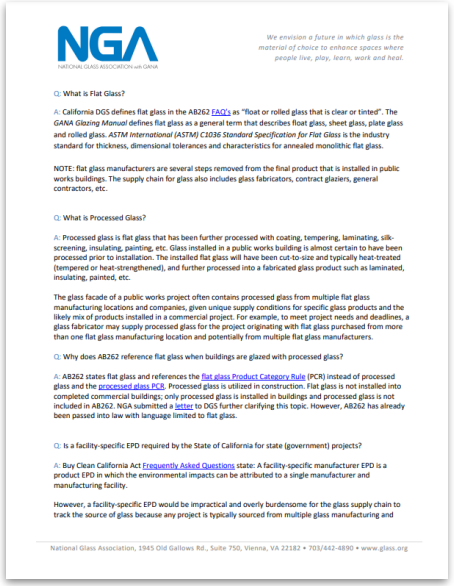
According to California Department of General Services website:

> The Buy Clean California Act, (Public Contract Code § 3500-3505), states the Department of General Services (DGS) is required to establish and publish the maximum acceptable Global Warming Potential (GWP) per product. The target for the Act is embedded carbon emissions of structural steel (hot-rolled sections, hollow structural sections, and plate), concrete reinforcing steel, **flat glass**, and mineral wool board insulation. When these materials are utilized in a California public works project, they must have a GWP that does not exceed the limit set by DGS.
>
> Key legislation dates:
>
> - January 1, 2020 – Awarding authorities will require submission of EPDs.
> - January 1, 2021 – DGS will publish the maximum acceptable GWP for eligible materials.
> - July 1, 2021 – Awarding authorities will gauge GWP compliance of eligible materials with EPDs.
>
> EPD submissions shall be developed according to Product Category Rules (PCRs).

Flat Glass

The National Glass Association (NGA) has developed a PCR for flat glass (UN CPC 3711) with validity extended through September 30, 2020. NGA continues to work with supporters and other interested parties to clarify the language of the bill, ensure they understand the effects, and provide education about glass and glazing supply.

National Glass Association, 1945 Old Gallows Rd., Suite 750, Vienna, VA 22182 • 703/442-4890 • www.glass.org



NGA

NATIONAL GLASS ASSOCIATION with GANA

We envision a future in which glass is the material of choice to enhance spaces where people live, play, learn, work and heal.

Q: What is Flat Glass?

A: California DGS defines flat glass in the AB262 FAQ's as "float or rolled glass that is clear or tinted". The *GANA Glazing Manual* defines flat glass as a general term that describes float glass, sheet glass, plate glass and rolled glass. *ASTM International (ASTM) C1036 Standard Specification for Flat Glass* is the industry standard for thickness, dimensional tolerances and characteristics for annealed monolithic flat glass.

NOTE: flat glass manufacturers are several steps removed from the final product that is installed in public works buildings. The supply chain for glass also includes glass fabricators, contract glaziers, general contractors, etc.

Q: What is Processed Glass?

A: Processed glass is flat glass that has been further processed with coating, tempering, laminating, silk-screening, insulating, painting, etc. Glass installed in a public works building is almost certain to have been processed prior to installation. The installed flat glass will have been cut-to-size and typically heat-treated (tempered or heat-strengthened), and further processed into a fabricated glass product such as laminated, insulating, painted, etc.

The glass facade of a public works project often contains processed glass from multiple flat glass manufacturing locations and companies, given unique supply conditions for specific glass products and the likely mix of products installed in a commercial project. For example, to meet project needs and deadlines, a glass fabricator may supply processed glass for the project originating with flat glass purchased from more than one flat glass manufacturing location and potentially from multiple flat glass manufacturers.

Q: Why does AB262 reference flat glass when buildings are glazed with processed glass?

A: AB262 states flat glass and references the flat glass Product Category Rule (PCR) instead of processed glass and the processed glass PCR. Processed glass is utilized in construction. Flat glass is not installed into completed commercial buildings; only processed glass is installed in buildings and processed glass is not included in AB262. NGA submitted a letter to DGS further clarifying this topic. However, AB262 has already been passed into law with language limited to flat glass.

Q: Is a facility-specific EPD required by the State of California for state (government) projects?

A: Buy Clean California Act Frequently Asked Questions state: A facility-specific manufacturer EPD is a product EPD in which the environmental impacts can be attributed to a single manufacturer and manufacturing facility.

However, a facility-specific EPD would be impractical and overly burdensome for the glass supply chain to track the source of glass because any project is typically sourced from multiple glass manufacturing and

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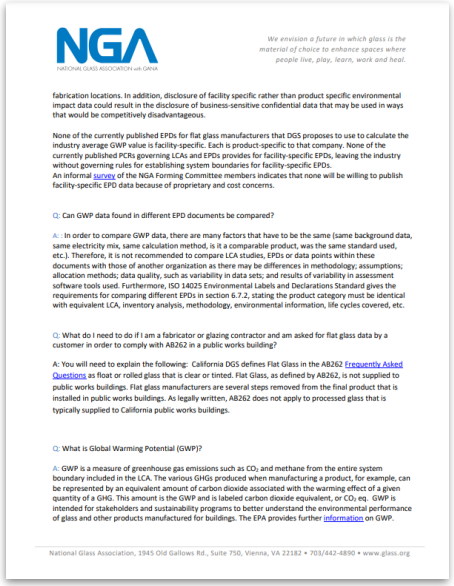

NGA

NATIONAL GLASS ASSOCIATION with GANA

We envision a future in which glass is the material of choice to enhance spaces where people live, play, learn, work and heal.

fabrication locations. In addition, disclosure of facility specific rather than product specific environmental impact data could result in the disclosure of business-sensitive confidential data that may be used in ways that would be competitively disadvantageous.

None of the currently published EPDs for flat glass manufacturers that DGS proposes to use to calculate the industry average GWP value is facility-specific. Each is product-specific to that company. None of the currently published PCRs governing LCAs and EPDs provides for facility-specific EPDs, leaving the industry without governing rules for establishing system boundaries for facility-specific EPDs.
An informal survey of the NGA Forming Committee members indicates that none will be willing to publish facility-specific EPD data because of proprietary and cost concerns.

Q: Can GWP data found in different EPD documents be compared?

A: In order to compare GWP data, there are many factors that have to be the same (same background data, same electricity mix, same calculation method, is it a comparable product, was the same standard used, etc.). Therefore, it is not recommended to compare LCA studies, EPDs or data points within these documents with those of another organization as there may be differences in methodology; assumptions; allocation methods; data quality, such as variability in data sets; and results of variability in assessment software tools used. Furthermore, ISO 14025 Environmental Labels and Declarations Standard gives the requirements for comparing different EPDs in section 6.7.2, stating the product category must be identical with equivalent LCA, inventory analysis, methodology, environmental information, life cycles covered, etc.

Q: What do I need to do if I am a fabricator or glazing contractor and am asked for flat glass data by a customer in order to comply with AB262 in a public works building?

A: You will need to explain the following: California DGS defines Flat Glass in the AB262 Frequently Asked Questions as float or rolled glass that is clear or tinted. Flat Glass, as defined by AB262, is not supplied to public works buildings. Flat glass manufacturers are several steps removed from the final product that is installed in public works buildings. As legally written, AB262 does not apply to processed glass that is typically supplied to California public works buildings.

Q: What is Global Warming Potential (GWP)?

A: GWP is a measure of greenhouse gas emissions such as CO_2 and methane from the entire system boundary included in the LCA. The various GHGs produced when manufacturing a product, for example, can be represented by an equivalent amount of carbon dioxide associated with the warming effect of a given quantity of a GHG. This amount is the GWP and is labeled carbon dioxide equivalent, or CO_2 eq. GWP is intended for stakeholders and sustainability programs to better understand the environmental performance of glass and other products manufactured for buildings. The EPA provides further information on GWP.

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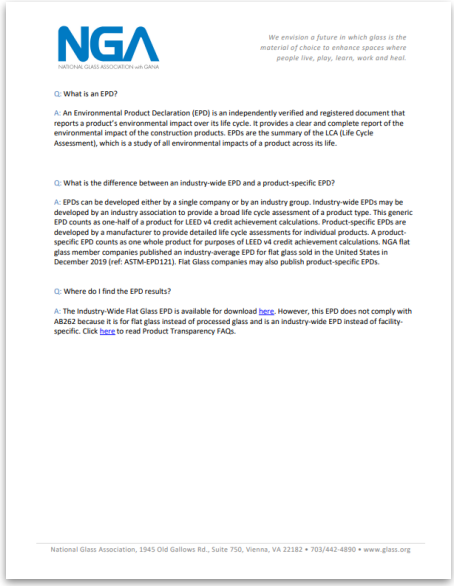

NGA

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Q: What is an EPD?

A: An Environmental Product Declaration (EPD) is an independently verified and registered document that reports a product's environmental impact over its life cycle. It provides a clear and complete report of the environmental impact of the construction products. EPDs are the summary of the LCA (Life Cycle Assessment), which is a study of all environmental impacts of a product across its life.

Q: What is the difference between an industry-wide EPD and a product-specific EPD?

A: EPDs can be developed either by a single company or by an industry group. Industry-wide EPDs may be developed by an industry association to provide a broad life cycle assessment of a product type. This generic EPD counts as one-half of a product for LEED v4 credit achievement calculations. Product-specific EPDs are developed by a manufacturer to provide detailed life cycle assessments for individual products. A product-specific EPD counts as one whole product for purposes of LEED v4 credit achievement calculations. NGA flat glass member companies published an industry-average EPD for flat glass sold in the United States in December 2019 (ref: ASTM-EPD121). Flat Glass companies may also publish product-specific EPDs.

Q: Where do I find the EPD results?

A: The Industry-Wide Flat Glass EPD is available for download here. However, this EPD does not comply with AB262 because it is for flat glass instead of processed glass and is an industry-wide EPD instead of facility-specific. Click here to read Product Transparency FAQs.

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https://www.glass.org/sites/default/files/2020-04/NGA.EPD%20FAQs%2004.2020.pdf

Environmental Product Declaration

According to ISO 14025

Flat Glass

This EPD was not written to support comparative assertions. Even for similar products, differences in declared unit, use and end-of-life stage assumptions, and data quality may produce incomparable results. It is not recommended to compare EPDs with another organization, as there may be differences in methodology, assumptions, allocation methods, data quality such as variability in data sets, and results of variability in assessment software tools used.

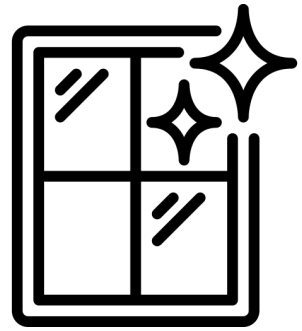
Issue Date: December 20, 2019

Valid Until: December 20, 2024

Declaration Number: 121

Declaration Number: ASTM-EPD121

Industry-average EPD not acceptable as a BCCA/CalGreen submittal but informs the industry-average threshold, and the baseline.



EVALUATION VARIABLE	UNIT PER METRIC TONNE	TOTAL
Global warming potential	kg CO_2 eq.	1.43E+03
Acidification potential	kg SO_2 eq.	6.59E+00
Eutrophication potential	kg N eq.	3.49E-01
Ozone depletion potential	kg CFC-11 eq.	2.48E-09
Smog formation potential	kg O_3 eq.	1.68E+02
Mineral resource depletion potential	kg Fe eq.	1.42E+01

CALGreen GWP Prescriptive Path Mandatory Limits

Mandatory
175% of IW-EPD GWP Limits

Tier 1
150% of IW-EPD GWP Limits

Tier 2
IW-EPD GWP Limits

TABLE 5.409.3
PRODUCT GWP LIMITS

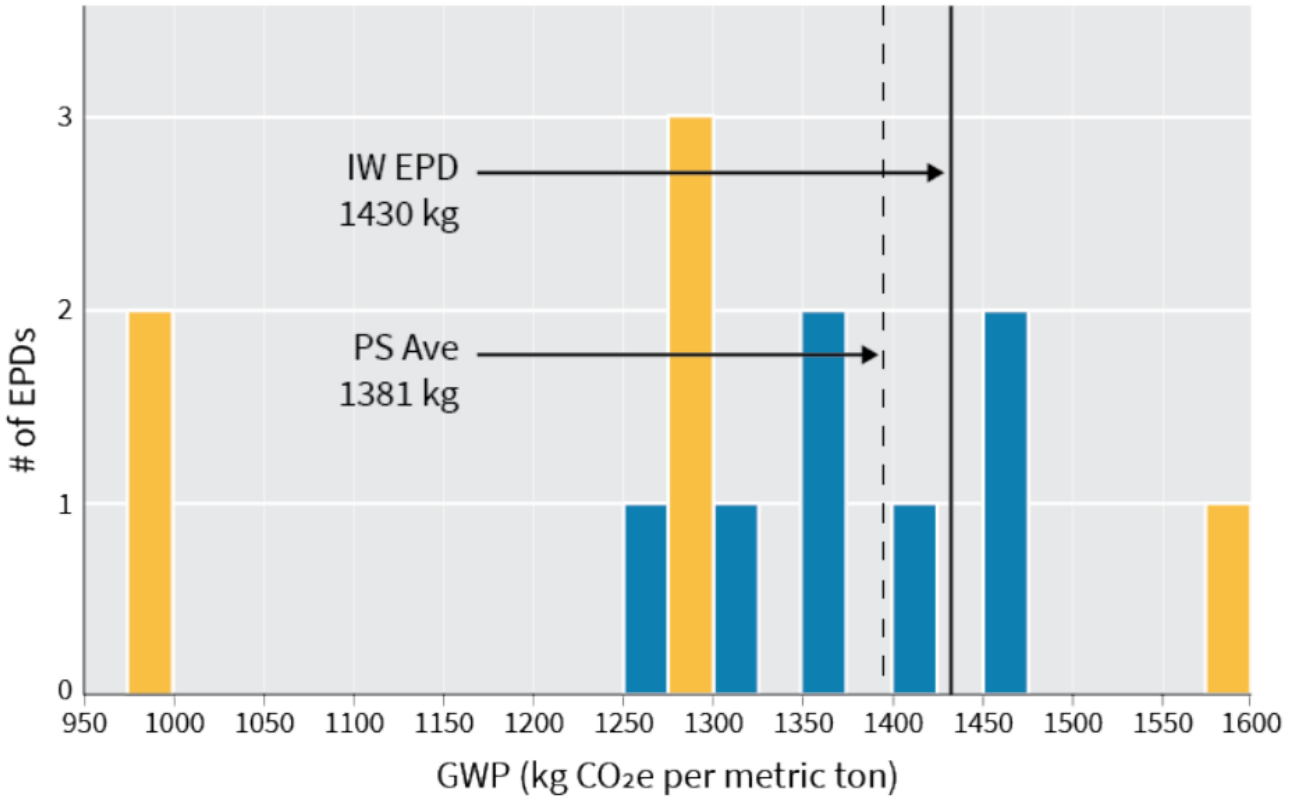
Buy Clean California Materials Product Category [1]	Maximum acceptable GWP value (unfabricated) ($GWP_{allowed}$)	Unit of Measurement
Hot-rolled structural steel sections	1.77	MT CO_{2e}/MT
Hollow structural sections	3.00	MT CO_{2e}/MT
Steel plate	2.61	MT CO_{2e}/MT
Concrete reinforcing steel	1.56	MT CO_{2e}/MT
Flat glass	2.50	kg CO_{2e}/MT
Light-density mineral wool board insulation	5.83	kg CO_{2e}/1 m^2
Heavy-density mineral wool board insulation	14.28	kg CO_{2e}/1 m^2

Concrete, Ready-Mixed [2, 3]

Concrete Product Category	Maximum GWP allowed value ($GWP_{allowed}$)	Unit of Measurement
up to 2499 psi	450	kg CO_{2e}/m^3
2500-3499 psi	489	kg CO_{2e}/m^3
3500-4499 psi	566	kg CO_{2e}/m^3
4500-5499 psi	661	kg CO_{2e}/m^3
5500-6499 psi	701	kg CO_{2e}/m^3
6500 psi and greater	799	kg CO_{2e}/m^3

Concrete, Lightweight Ready-Mixed [2]

Concrete Product Category	Maximum GWP allowed value ($GWP_{allowed}$)	Unit of Measurement
up to 2499 psi	875	kg CO_{2e}/m^3
2500-3499 psi	956	kg CO_{2e}/m^3
3500-4499 psi	1,039	kg CO_{2e}/m^3



Product-specific EPDs

13 EPDs / 10 manufacturers

Applicable to limit-setting

7 EPDs / 3 manufacturers / 15 facilities

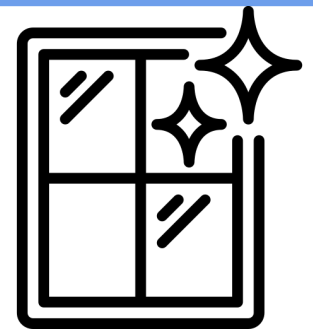
BCCA Applicable

Yes

No

Figure 5. Flat Glass EPDs: Distribution of product-specific EPD GWP values for flat glass compared with the industry-wide EPD value. Source: EC3 database, December 2021. BCCA Applicable EPDs (indicated in blue) are EPDs for North American products that meet the product category description and follow the PCR identified by DGS. "PS Ave" is the average of the applicable product-specific EPD values.

https://carbonleadershipforum.org/wp-content/uploads/2022/06/CLF-BCCA-Limits-2022-02-16-updated.pdf



Glass Compliance Flowchart:

1. Compliance pathway: LCA or Prescriptive?
2. Flat glass or not? (not: tempered, heat strengthened, coated, laminated, fritted)
3. Note: Flat glass in IGU needs to comply with CalGreen / BCCA requirements
4. Search databases/producers for Type III, facility- or product- specific EPDs of :

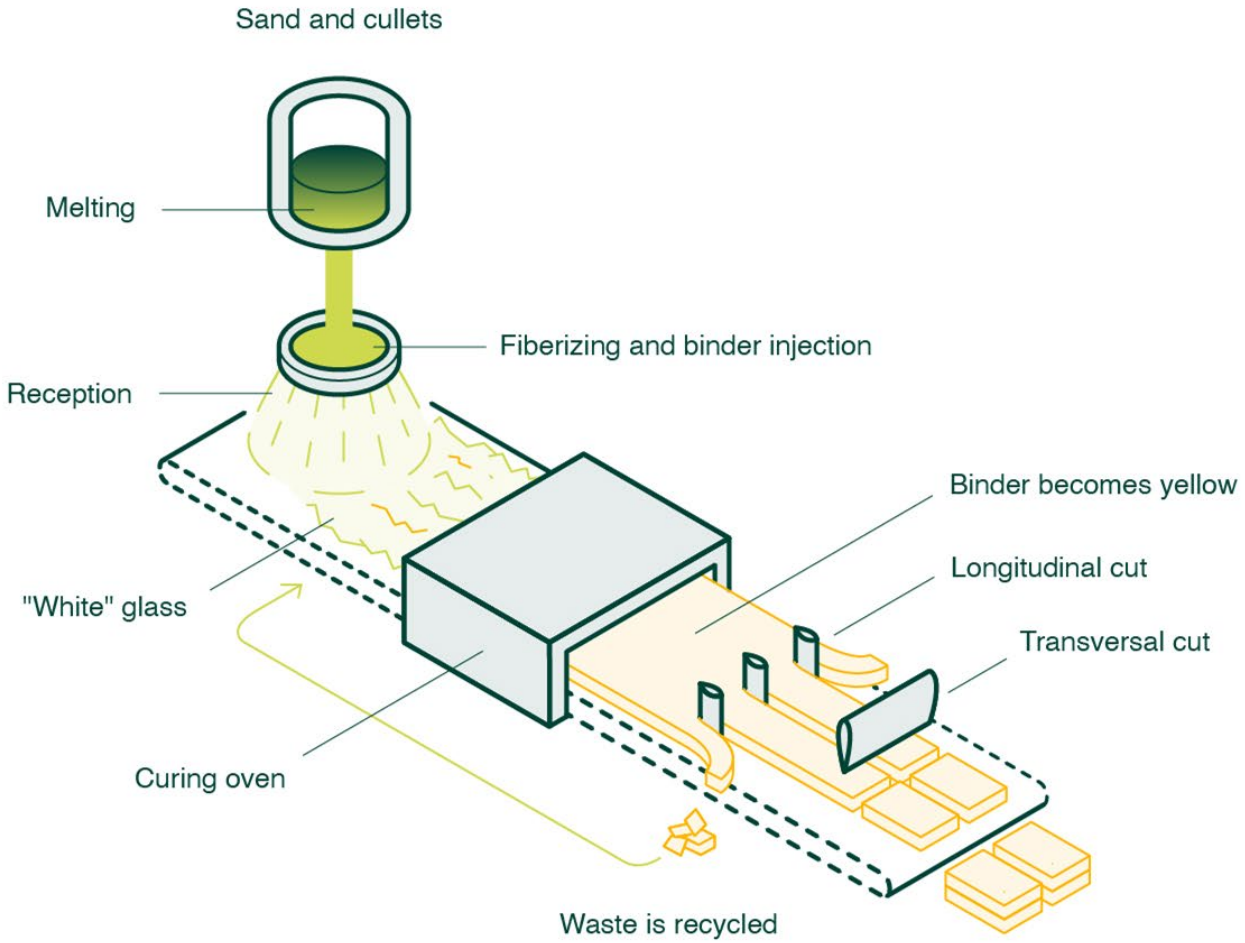
Functionally equivalent materials, size and thickness, specification, use, life span

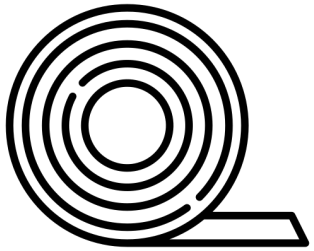
Example: *if a glass product requires replacement during the 60 years' building life span, its GWP needs to be re-added each time it is replaced. For example some facade systems have life expectancy (or historical record/tests) significantly below 60 years.*

Tips:

- *Compare EPD only if defined per same BCCA/CalGreen compliant PCR, EPD Type, functional unit.*
- *Window frame does not typically need to comply with CalGreen (unless frame is one of the BCCA materials).*

Mineral Wool Insulation


Sand and cullets
Melting
Fiberizing and binder injection
Reception
Binder becomes yellow
Longitudinal cut
"White" glass
Transversal cut
Curing oven
Waste is recycled



CALGreen GWP Performance Mandatory Limits

Mandatory
175% of IW-EPD GWP Limits

Tier 1
150% of IW-EPD GWP Limits

Tier 2
IW-EPD GWP Limits

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Concrete, Ready-Mixed [2, 3]

Concrete Product Category	Maximum GWP allowed value ($GWP_{allowed}$)	Unit of Measurement
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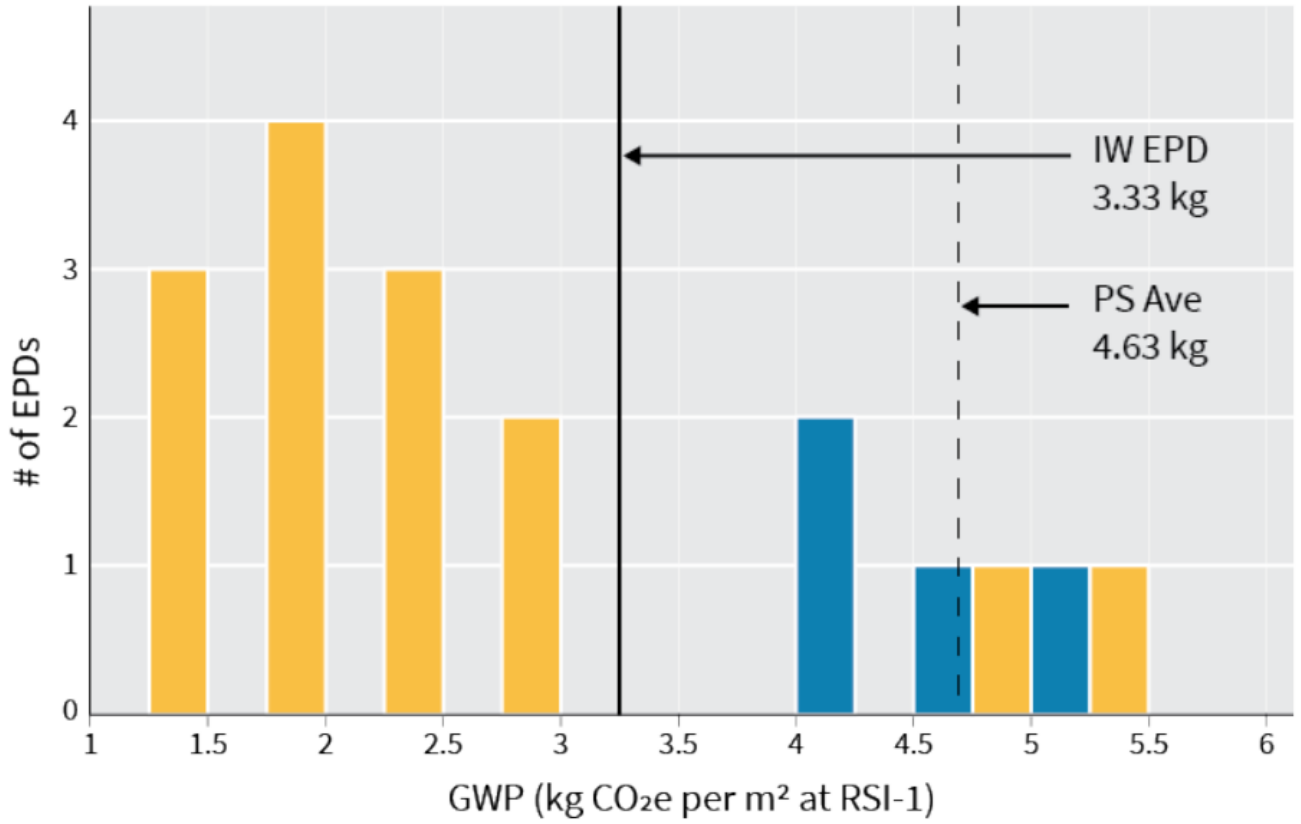


Product-specific EPDs

18 EPDs / 5 manufacturers

Applicable to limit-setting

4 EPDs / 1 manufacturer

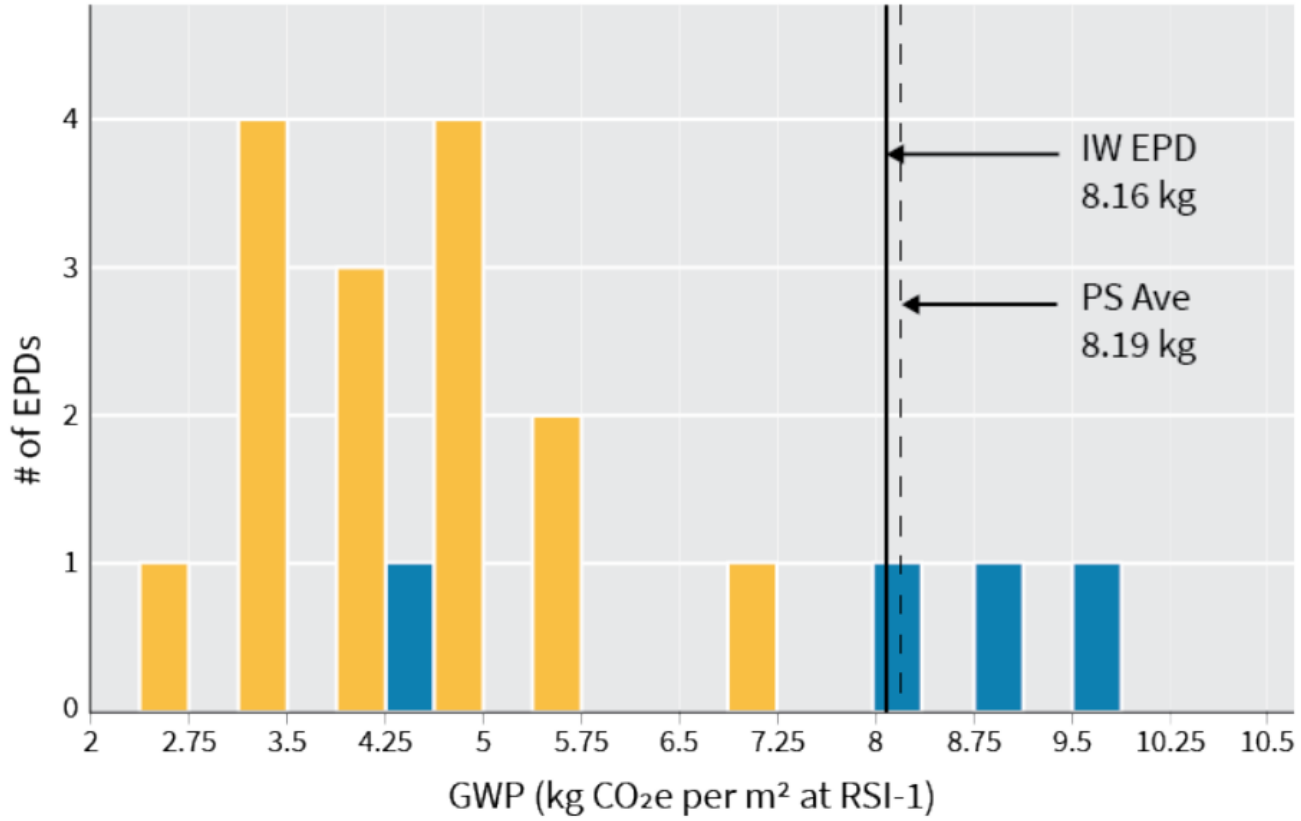
BCCA Applicable

Yes

No

Figure 6. Light-Density Mineral Wool Board EPDs: Distribution of product-specific EPD GWP values for light-density mineral wool board insulation compared with the industry-wide EPD values. Source: EC3 database, December 2021. BCCA Applicable EPDs (indicated in blue) are EPDs for North American products that meet the product category description and follow the PCR identified by DGS. "PS Ave" is the average of the applicable product-specific EPD values.

https://carbonleadershipforum.org/wp-content/uploads/2022/06/CLF-BCCA-Limits-2022-02-16-updated.pdf



Product-specific EPDs

19 EPDs / 5 manufacturers

Applicable to limit-setting

4 EPDs / 1 manufacturer

BCCA Applicable

Yes

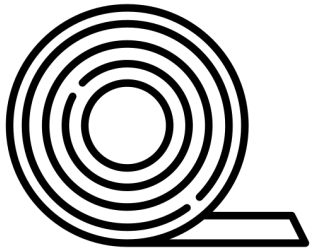
No

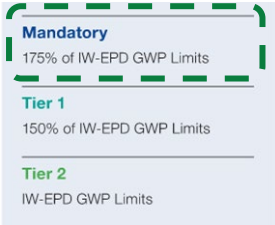
Figure 7. Heavy-Density Mineral Wool Board EPDs: Distribution of product-specific EPD GWP values for heavy-density mineral wool board insulation compared with the industry-wide EPD values. Source: EC3 database, December 2021. BCCA Applicable EPDs (indicated in blue) are EPDs for North American products that meet the product category description and follow the PCR identified by DGS. "PS Ave" is the average of the applicable product-specific EPD values.

https://carbonleadershipforum.org/wp-content/uploads/2022/06/CLF-BCCA-Limits-2022-02-16-updated.pdf

Insulation Compliance Flowchart:

1. Compliance pathway: LCA or Prescriptive?
2. Light/Heavy Density? R value?
3. Search databases/producers for Type III, facility- or product- specific EPDs of :





Functionally equivalent
materials, size, specification, use, life span

Tips:

- *Check out expiration dates and talk to producers about upcoming EPD releases.*
- *If your supplier cannot meet the strict documents requirements by the time of permitting, see if your AHJ exceptionally accepts hybrid submittals for your project.*

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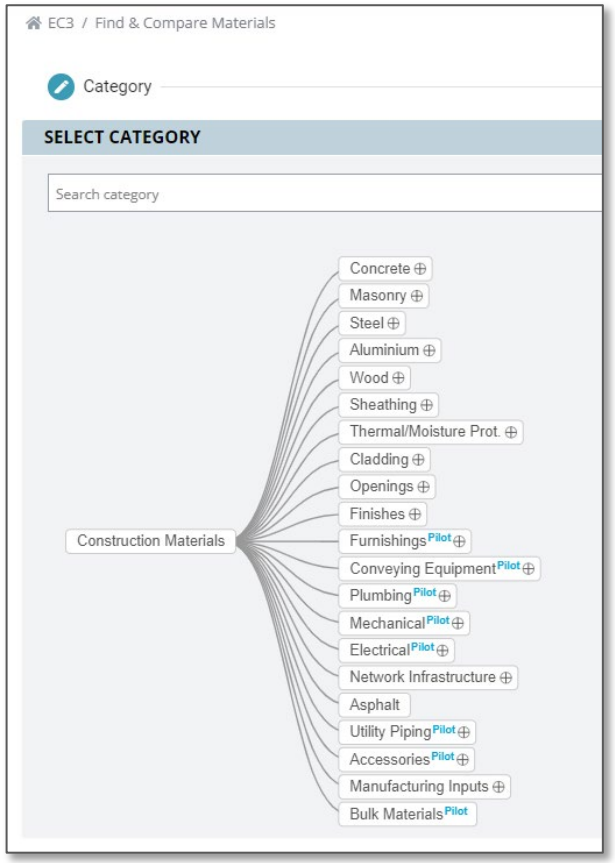
Resources

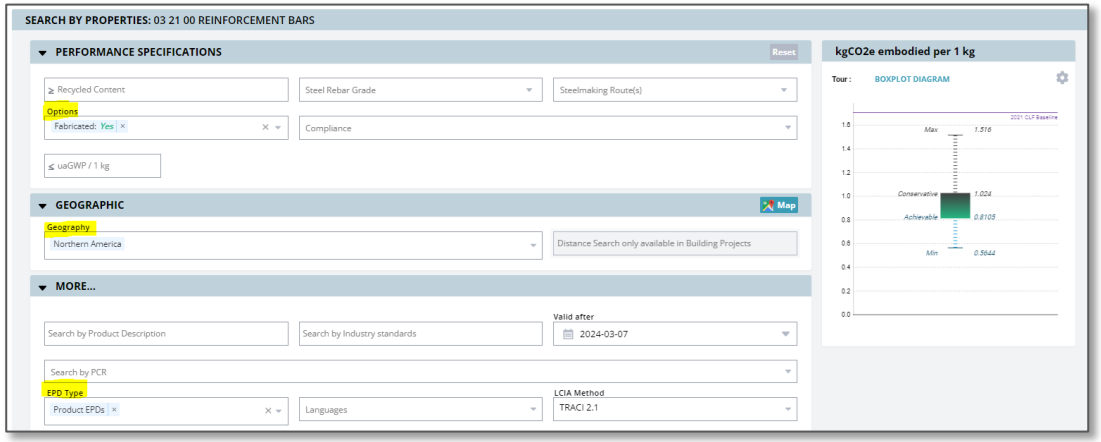
EC3 Tips and Tricks

EC3 | Product Level

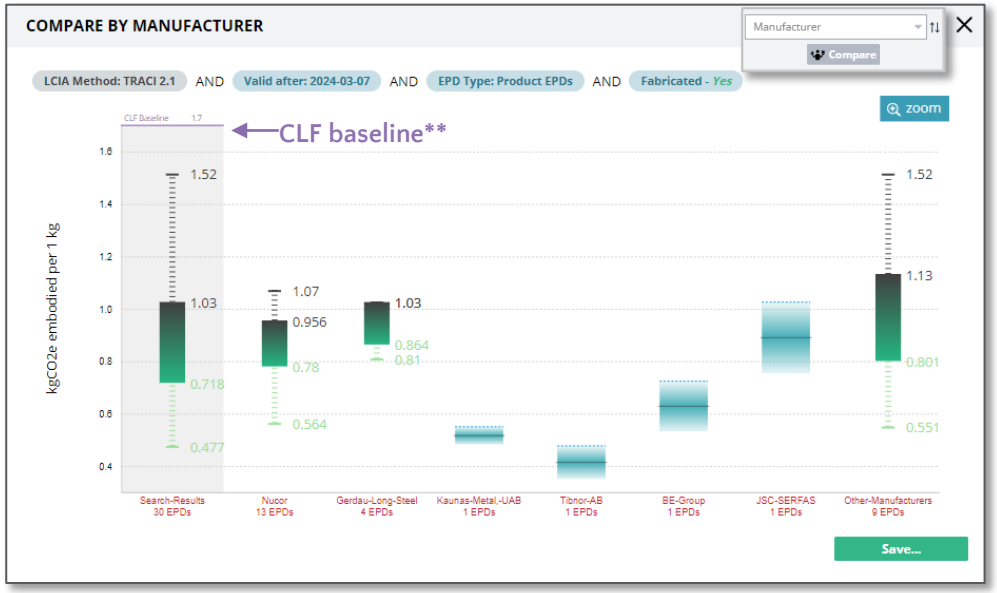
1 Choice of category



2 Setting filters/ functional equivalence



3 Choice of comparison (can also order by GWP in raw results table/ download data)



Shivanie Rambaran (Buro Happold)

Resources

Where to start:

- FREE Calgreen code access
- Local Energy Codes – CALGreen Fact Sheet
- Embodied Carbon in Construction Calculator (EC3)
- Sustainable Minds Transparency Catalog
- SE 2050 Specification Guidance
- Carbon Leadership Forum Material Baselines

Where to learn more:

Steel:

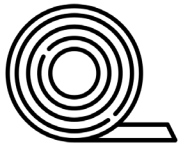
- Nucor Steel Spec Guidance
- AISC Sustainability Webpage
- AISC Environmental Product Declarations
- AISC Who Makes the Shapes You Need?
- STI HSS Producers Capability Tool

Concrete:

- NRMCA Guide to Improving Specifications for Ready Mixed Concrete
- Central Concrete, Spec Guide: Capturing the Value of Low Carbon Mixes
- NRMCA Guide to Specifying Concrete for LEED v4
- NRMCA Environmental Product Declarations
- Climate Earth Locate a Concrete Producer offering Instant On-Demand EPDs
- NRMCA Concrete Carbon Calculator

Glass:

- Review of decarbonization options for the glass industry
- Arup, Carbon footprint of façades: significance of glass



Insulation:

- Which insulation most effectively reduces whole-life carbon (embodied and operational)?
- Gensler Product Sustainability Standards (GPS Standards v1.0)

Moderated Discussion and Q&A