Low Carbon Concrete in Ontario

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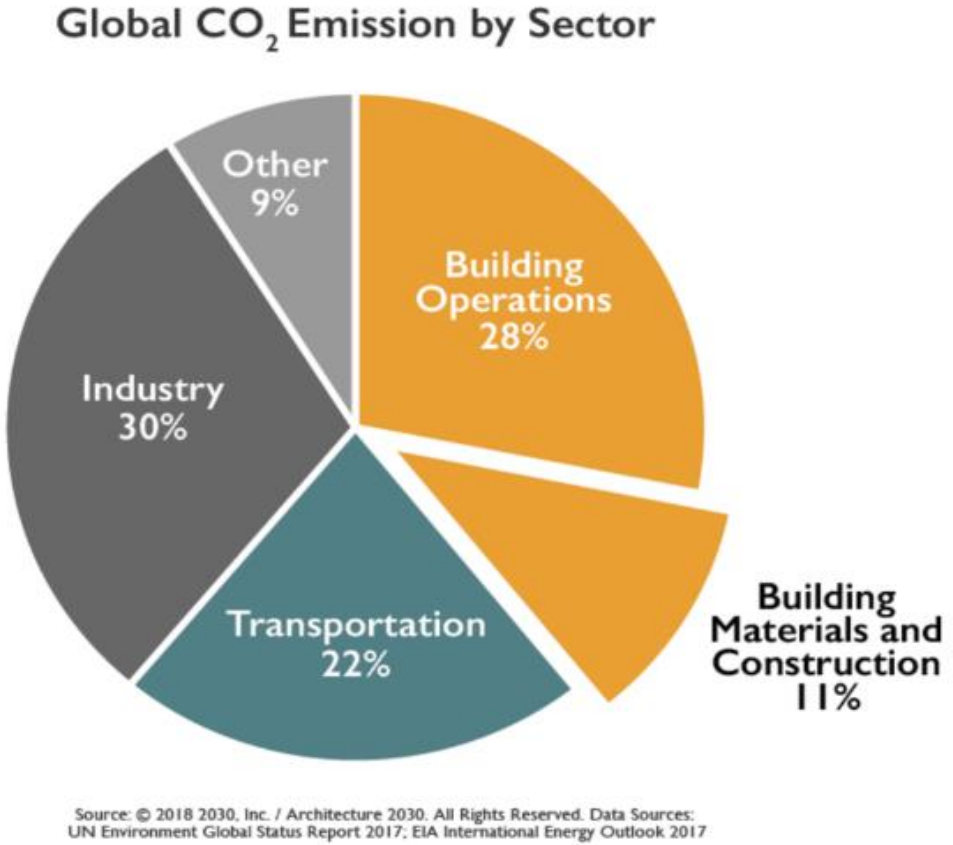
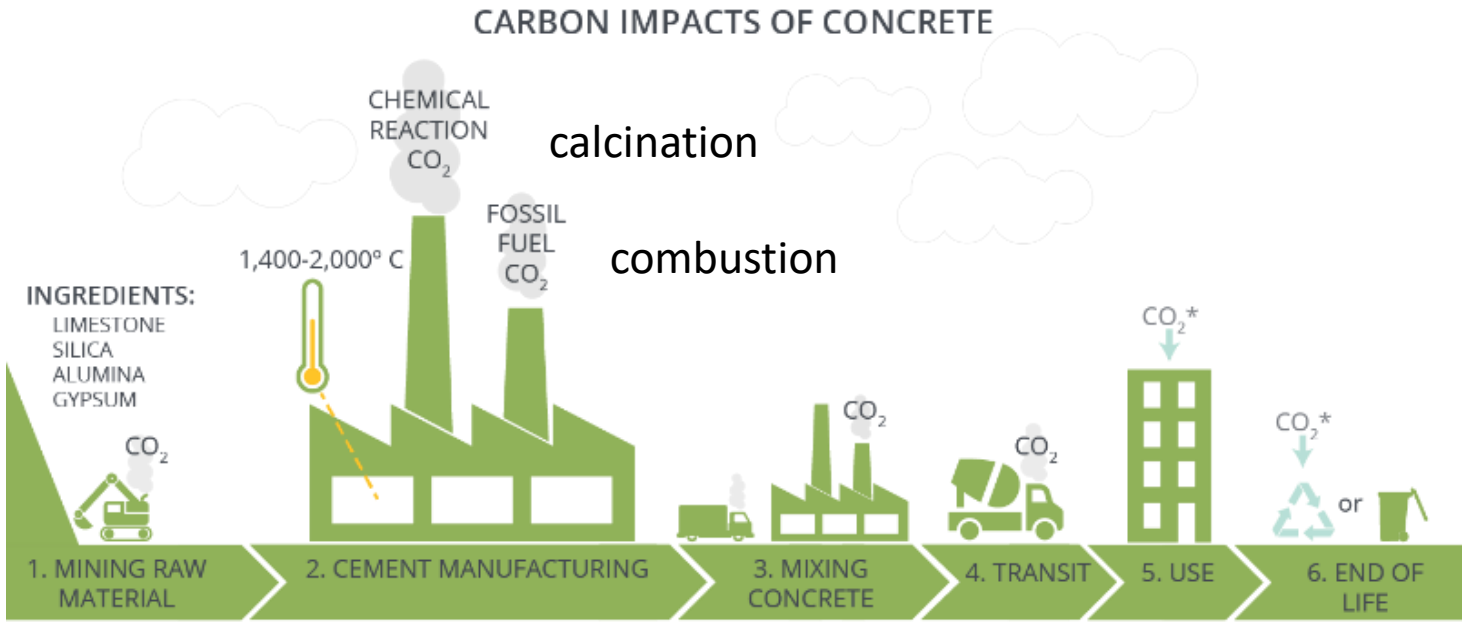
What is Embodied Carbon?

- Embodied Carbon of **Materials**
  - Extraction and manufacturing
- Embodied Carbon of **Buildings**
  - Materials + transportation, construction
  - (sometimes) end of life carbon impacts

*i.e. **"upfront"** carbon*



Concrete Carbon Lifecycle



Despite representing only 10-15% of the concrete mix, cement contributes 80-85% of the total carbon footprint

END OF LIFE:
Over 95% of concrete is recycled at the end of its useful life, either ground up to make concrete aggregate or even new concrete

How do we measure the impact of carbon?

- How would you measure the impact of calories?

PAVE AHEAD
DURABLE. SUSTAINABLE. CONCRETE.

“EPDs are Key to Concrete’s Sustainable Future”

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Environmental Product Declarations (EPDs)

- EPDs for concrete are much like nutrition labels for common foods

- Most important metric is the **Global Warming Potential (GWP)** which is calculated in kg CO_2/m^3

Food Nutritional Labels
Health Impacts

Nutrition Facts

Serving Size 2/3 cup (55g)
Servings Per Container About 8

Amount Per Serving

Calories 230	Calories from Fat 40
	% Daily Value*
Total Fat 8g	**12%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 37g	**12%**
Dietary Fiber 4g	**16%**
Sugars 1g	
Protein 3g	
Vitamin A	10%
Vitamin C	8%
Calcium	20%
Iron	45%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Product EPDs
Environmental Impacts

Environmental Impacts

Declared Product:
Mix 4F05C5Q1 + Bode Plant
EF50 Gen Use 4" line w/o .50
Compressive strength: 4000 psi at 28 days

Declared Unit: 1 m^3 of concrete

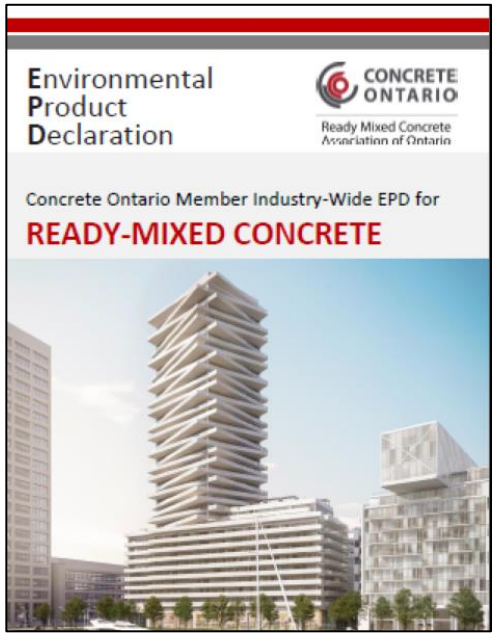
Global Warming Potential (kg CO_2-eq)	272
Ozone Depletion Potential (kg CFC-11-eq)	7.46E-6
Acidification Potential (kg SO_2-eq)	2.65
Eutrophication Potential (kg N-eq)	0.37
Photochemical Smog Creation Potential (kg O_3-eq)	53.8
Total Primary Energy Consumption (MJ)	2,577
Nonrenewable (MJ)	2,504
Renewable (MJ)	73.7
Total Concrete Water Consumption (m^3)	2.65
Batching Water (m^3)	0.69
Washing Water (m^3)	8.80-3
Nonrenewable Material Resource Consumption (kg)	2,484
Renewable Material Resource Consumption (kg)	1.57
Hazardous Waste Production (kg)	0.01
Nonhazardous Waste Production (kg)	2.76

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

2017 CRMCA Report

- Represents data for an average ready-mix concrete plant in Canada
- 25MPa – 60MPa
- Benchmarks set at 6% Slag and 4% Fly Ash
- Expired on January 6, 2022

Concrete Ontario Member Industry-Wide EPD for Ready-Mixed Concrete (July 2022)



Building Life Cycle Information Modules															
Product stage			Construction Process stage		Use stage							End-of-life stage			
Raw Material supply	Transport	Manufacturing	Transport	Construction/Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/	Transport	Waste processing	Disposal
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4

Figure 1: Life cycle stage schematic – alpha-numeric designations as per NSF PCR 2021

EVOLUTION OF LOW CARBON CONCRETE IN ONTARIO

1 **January 2017**
CRMCA Industry-Average EPD Report released

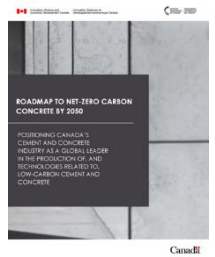
2 **October 2021**
First Ontario low carbon concrete specification

3 **January 2022**
CRMCA report expires

4 **July 2022**
Ontario Industry-Average EPD report released

5 **October 2022**
ConcreteCarbon Guideline released

6 **November 2022**
Roadmap to Net-Zero Carbon Concrete



7 **November 2022**
Treasury Board Standard on Embodied Carbon in Construction

8 **November 2022**
ConcreteCarbon Guideline updated

9 **2030**
Carbon reduction goals

10 **2050**
Net-zero carbon concrete

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What is Low Carbon Concrete?

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What is Low Carbon Concrete?

- Low carbon concrete refers to concrete produced with a **lower carbon footprint than traditional mix designs**, while still meeting all relevant performance requirements
  - Strength, permeability, durability, etc.

- To employ low carbon concrete:

- Use available lower carbon impact materials
- Mix design optimization (Admixtures)
- Carbon mineralization technology
- Tools to quantify the carbon impact (EPDs)
- Project carbon budgeting

LCA & Concrete Carbon Accounting

How to reduce CO_2 on Your Project

- GUL versus GU – 10% reduction
- Maximize SCM's
- Specify lowest strength possible
- Avoid early strength
- Maximize admixture usage
- Build in warm weather

Agricultural Corrosion Conditions

OBC – Part 4

4.4.5.1. Liquid Manure Storage Tanks

(1) *Liquid manure* storage tanks shall be constructed of steel, reinforced concrete or prestressed concrete.

(2) *Liquid manure* storage tank walls, bases and appurtenances, including piping for the conveyance of *liquid manure* and associated connections and joints, shall be designed and constructed to prevent leakage of contents.

(3) Concrete for *liquid manure* storage tanks shall,
(a) be made from HS or HSb cement,
(b) have a 28-day strength of at least 32 MPa, and
(c) have a water/cement materials ratio of not more than 0.45.

Communicate carbon reduction goals

What Tools Is the Industry Providing?

- Ontario Industry Average EPDs
- Ontario Average SCM Usage by Mix Design
- Type II EPD Calculator with Ontario Raw Materials

Moving Forward in Ontario

Development of Embodied Carbon Management Toolkit for Ontario Municipalities

City of Toronto, 2023 | $153,000

The project aims to develop an Embodied Carbon Management Toolkit for Ontario's municipalities and support the development and implementation of embodied carbon management policies and practices across the province. Key deliverables that will be completed during this grant include:

- An Embodied Carbon Management Toolkit for municipal staff.
- An Assessment of the City of Toronto's Urban Design Guidelines for Low-Rise, Mid-Rise and Tall buildings to identify potential drivers of embodied and operational carbon and construction costs.
- Recommendations on design, procurement, and material specification processes to prioritize lower carbon materials in construction projects.
- Review of international best practices on demolition and deconstruction and recommendations for future amendments to revise the City of Toronto's approach.

Treasury Board of Canada Secretariat
Standard on Embodied Carbon in Construction

- Effective December 31, 2022, all federal projects budgeted at or above $10 million, using a minimum 100 m3 of ready mixed concrete
- Disclosure of **Type II or Type III EPDs**
- **10% reduction** from the total project GHG emissions from ready mixed concrete, using the GWPs of the baseline mixes in the Ontario Regional Industry Average Environmental Product Declaration (EPD) for the strength class of each mix and the volume of mix placed
- Where specialized concrete mixes are required for high early strength, high or ultra-high performance, and/or cold-weather applications, the baseline used for those mixes shall be **130% of the baseline mix** in the Ontario Regional Industry Average EPD for that strength class

What can you do today?

- Talk to your suppliers about their low-carbon solutions
- Get ahead of the curve; prepare for upcoming changes
- Familiarize with the 2050 net-zero action plan

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