

# Low Carbon Concrete

**Ted Moffatt, Ph.D., P.Eng**  
Senior Concrete Materials Engineer | Partner

W.S. Langley Concrete & Materials Technology  
A Division of Harbourside Engineering Group



*UNB Off-Site Construction Research Centre Lunch & Learn*  
*March 19, 2026*

# The Harbourside Group of Companies

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Concrete  
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THE HARBOURSIDE FAMILY  
[harboursideengineering.com](http://harboursideengineering.com)

# ABOUT DR. TED MOFFATT

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- Senior Materials Engineering – Concrete Technology
- Ph.D. in Civil Engineering – Concrete Materials
- Adjunct Professor at UNB Fredericton
- Adjunct Scholar at Dalhousie University
- Specialist in concrete durability, cement chemistry, NDT and Service Life Prediction Modelling
- 30+ Peer Reviewed Publications
- Voting Member – CSA A3000 and A23.1/2
- Past President – ACI Atlantic Chapter



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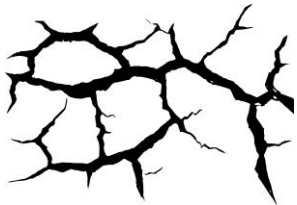
# OUR SERVICES

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## **Preconstruction**

- Specification Writing and Review
- Developing and Optimizing Mix Designs
- Low Carbon Concrete Consulting
- Durability Plans and Service Life Prediction Modelling
- Thermal Control Plans for Mass Concrete



## **Concrete Diagnostics**

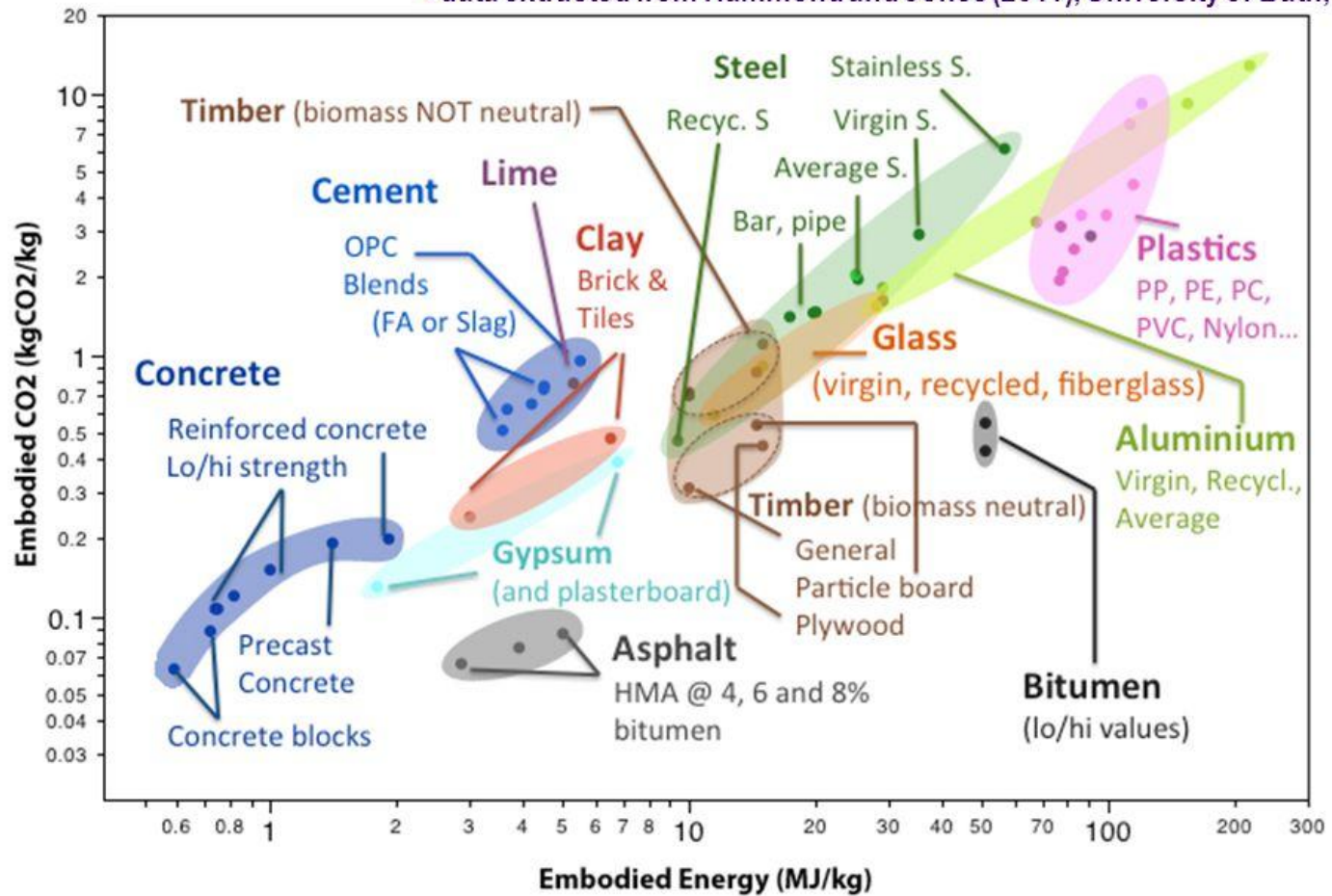
- Concrete Condition Assessments
- Evaluation of Concrete Durability Related Issues
- Non-Destructive Testing (NDT)
- Forensic Laboratory Testing



## **Technical Support**

- Troubleshooting for Contractors and Concrete Suppliers
- Expert Witness and Litigation Support
- R&D

• data extracted from Hammond and Jones (2011), University of Bath, UK



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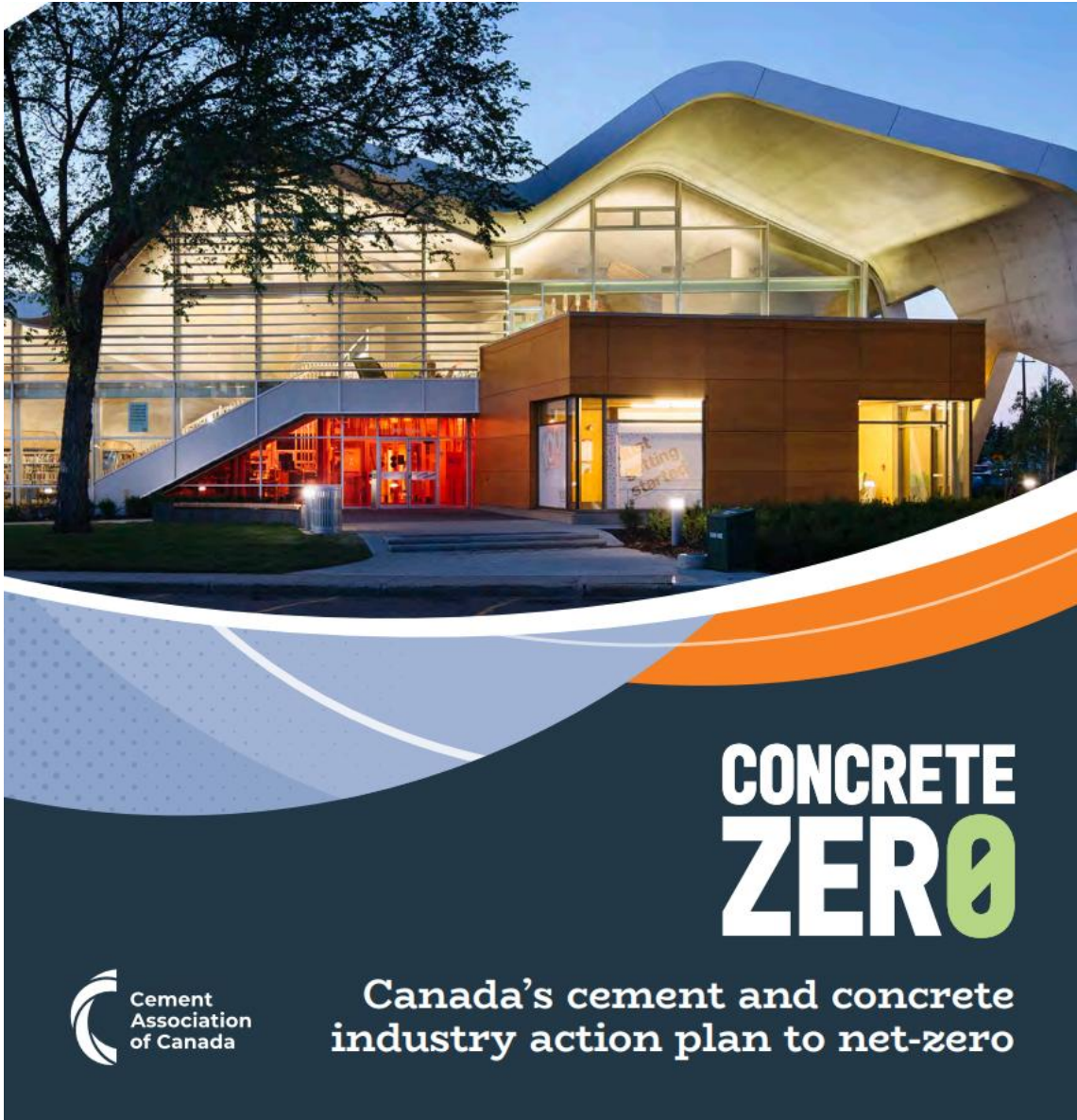
*UNB Off-Site Construction Research Centre Lunch & Learn*  
*March 19, 2026*

*Cement industry responsible for  
5-8% of planet-warming CO<sub>2</sub>  
emissions*

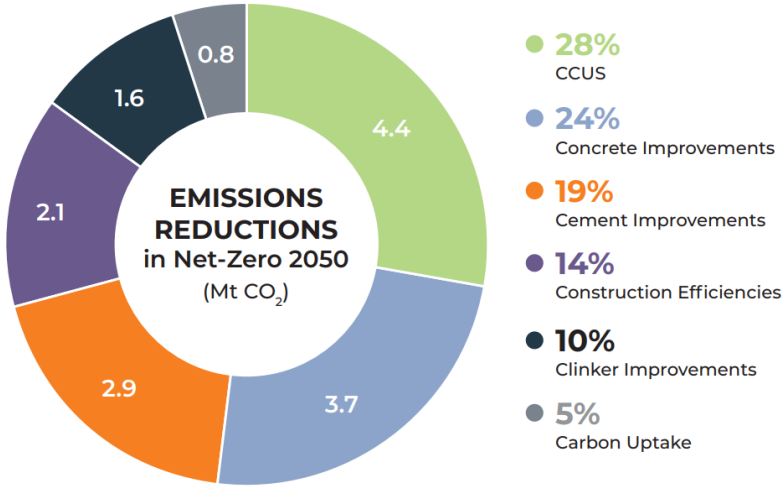


*In 2025, cement production worldwide  
amounted to an estimated **4.7 billion tons***





# Our Road to Net-Zero



## Action Plan Focused on 5 C's

1. Clinker
2. Cement
3. Concrete
4. Construction
5. Carbon Uptake



# WHAT IS LOW CARBON CONCRETE?

*“Concrete produced with a reduced carbon footprint compared to typical mix designs, while still meeting all necessary performance Standards”*

*(Concrete Ontario, 2025)*

**1 m<sup>3</sup>**

## **Traditional Concrete**

- Ordinary Portland cement
- Fly ash
- Water
- Admixtures

**35 MPa C-1**  
Baseline GWP

**< 1500 C**  
Baseline GWP

**1 m<sup>3</sup>**

## **Low Carbon Concrete**

- GUL cement
- Fly ash
- Water
- Admixtures

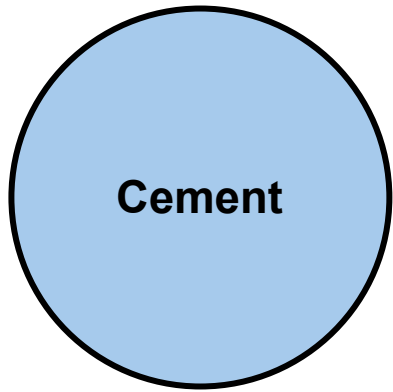
**35 MPa C-1**  
Baseline GWP

**< 1500 C**  
↓ GWP -15%

**Same strength ✓ Same volume Lower carbon**

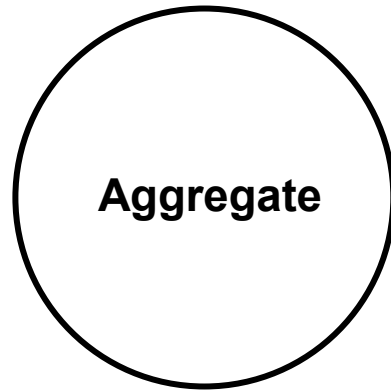
# STRATEGIES FOR LOW CARBON CONCRETE

1. Adjust “Age Strength” (i.e. 28D vs. 56D)
2. Performance-Based Design Requirements
3. Material Efficiency
4. Mixture Design Considerations
  - a. Use Portland-Limestone Cement
  - b. Maximize the use of SCMs, ASCMs, or Blended Cements
  - c. Aggregate Optimization
  - d. Use of Admixtures
  - e. Recycling/Reuse of Crushed Concrete



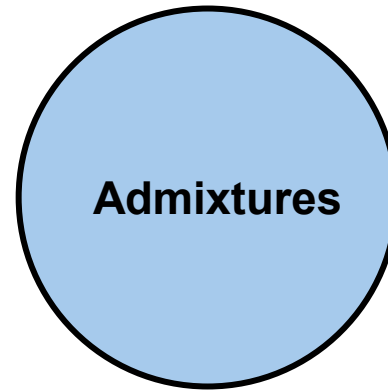
**Cement**

10 to 15%  
By  
volume



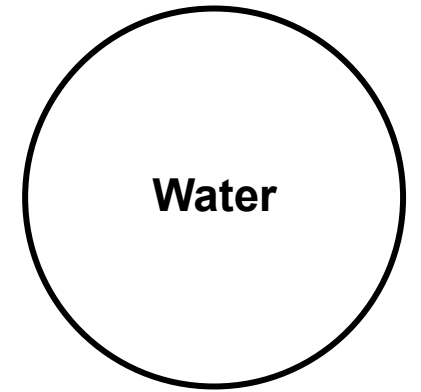
**Aggregate**

65 to 75%  
by  
volume

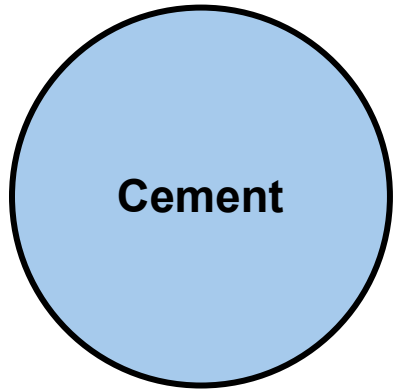


**Admixtures**

0.1 to 1%  
by  
volume



**Water**



**Cement  
component  
accounts for  
approximately  
85% of concrete  
emissions**

## **Portland Limestone Cement (GUL)**

## **Supplementary Cementing Materials (SCMs)**

- Fly Ash**
- Slag**
- Silica Fume**
- Glass Pozzolan**
- Natural Pozzolans (e.g. volcanic ash, metakaolin, pumice)**

## **Blended Cements**

**Calcium Aluminate Cement**

**Calcium Sulphoaluminate Cement**

**Magnesium Sulphate Cement**

# WHAT IS PORTLAND LIMESTONE CEMENT?

## Ordinary Portland Cement (CSA Type GU, ASTM Type I)



Clinker (91-93%) + up to 5-8% Gypsum + up to 5% Limestone

## Portland Limestone Cement (CSA Type GUL, ASTM Type IL)



Clinker (81-83%) + up to 5-8% Gypsum + 5-15% Limestone

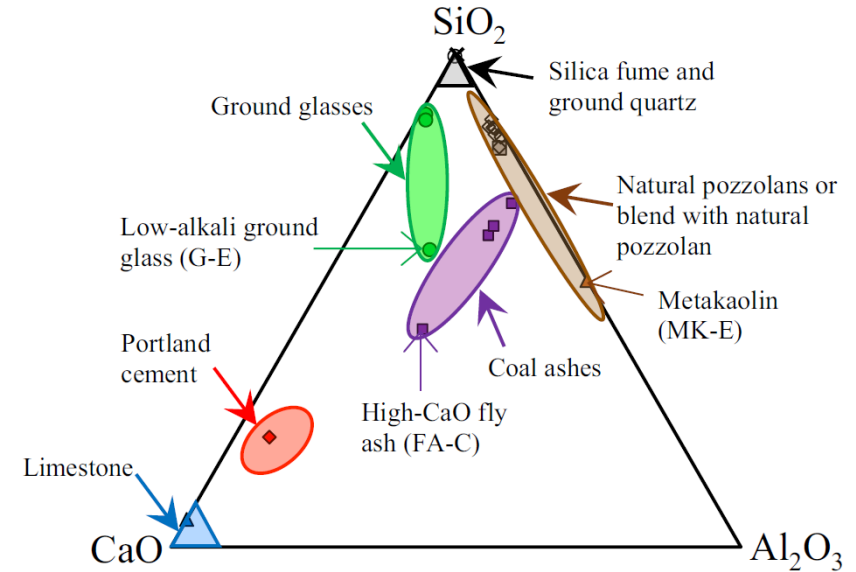
“Equivalent performance” is achieved by grinding GUL finer than GU.

GUL has a fineness approximately 100 to 120 m<sup>2</sup>/kg (Blaine) greater than GU.

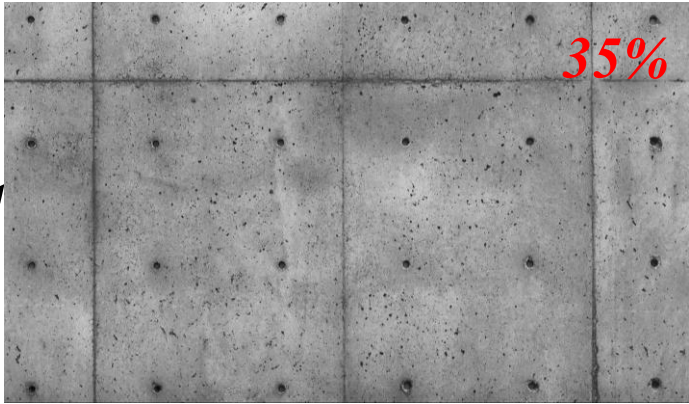
- Particle packing
- Limestone acts as nucleation sites
- CaCO<sub>3</sub> reacts with aluminate phases

# WHAT ARE SUPPLEMENTARY CEMENTING MATERIALS?

- Fly Ash
- Ground Granulated Blast Furnace Slag
- Silica Fume
- Ground Glass Pozzolan
- Natural Pozzolans



# FLY ASH



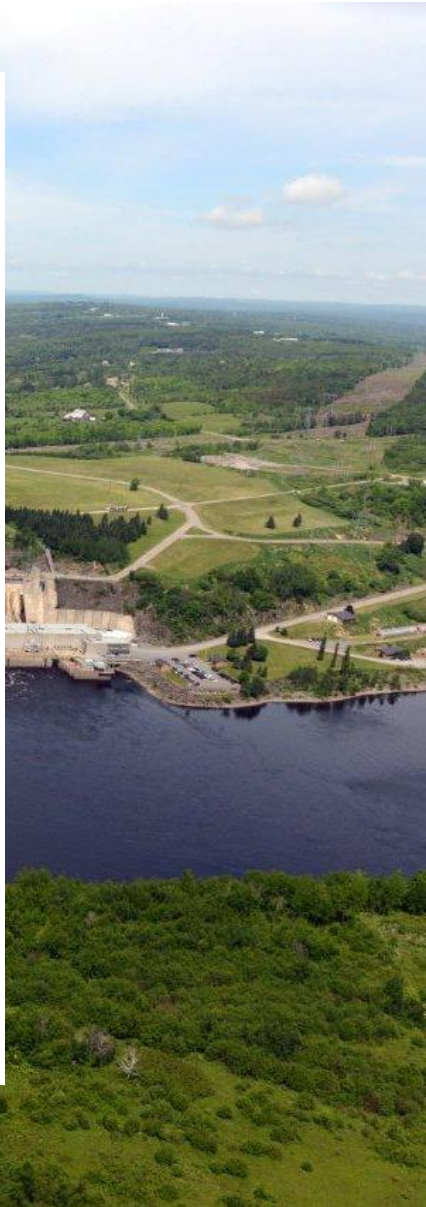
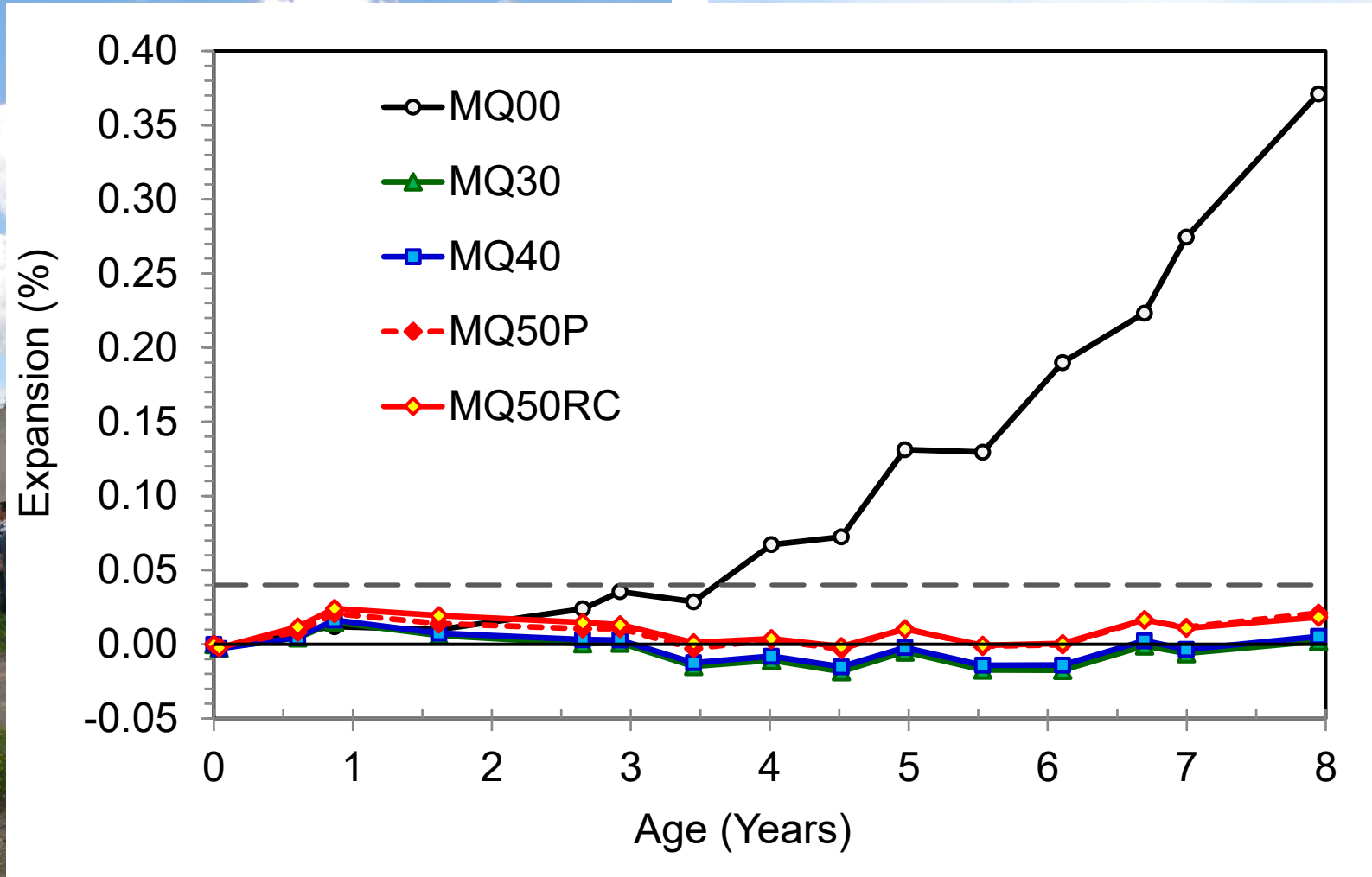
# FLY ASH



## Why use (harvested) fly ash in concrete?

- Reacts pozzolanically
- Environmentally friendly alternative to GU cement
- Reduce heat of hydration
- Long term strength gain
- Lower water demand
- Improved concrete durability (ASR, permeability, sulphate)

*ASTM E3183-19 Standard Guide for Harvesting Coal Combustion Products Store in Active and Inactive Storage Areas for Beneficial Use*



# GROUND GLASS POZZOLAN

## 1. Container Glass

Used as packaging

**8.4 million tons is landfilled annually (United States)**

## 2. Plate Glass

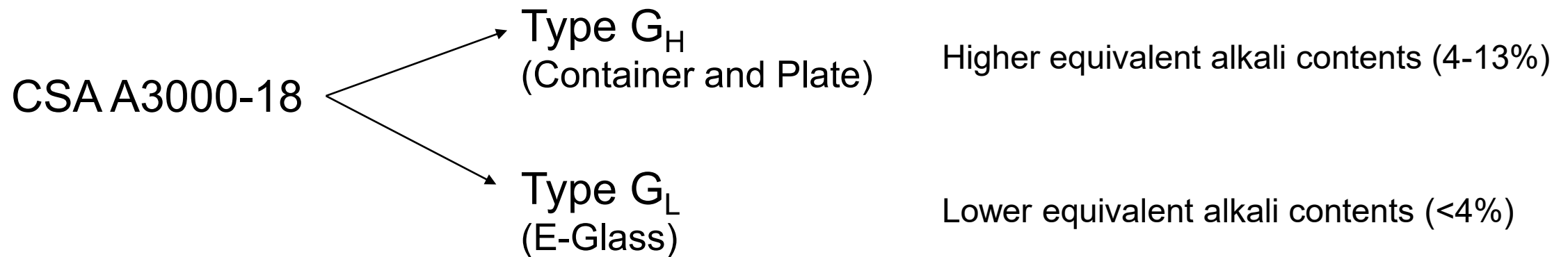
Used as glazing in buildings or automobiles

## 3. E-Glass

Used as reinforcement in fiber-reinforced polymers)

# GROUND GLASS POZZOLAN

In 2018, CSA A3000-18 *Cementitious materials compendium* approved ground glass pozzolan as a supplementary cementing material.



Regardless of type, Fineness (45um, max % retained) shall be less than 5%

# GROUND GLASS POZZOLAN



## Darwin Bridge, Montreal QC

### Concrete (type V-S):

Strength: 35 MPa (5000 psi)

Chloride ion penetrability: < 1000 Coulombs

w/c: 0.38 to 0.42

Slump: 130 mm +/- 30 mm

2.3 kg of synthetic fibers

Shrinkage compensating admixture

Shrinkage reducing admixture

GUb-S/SF (Blended Hydraulic Ternary Cement)

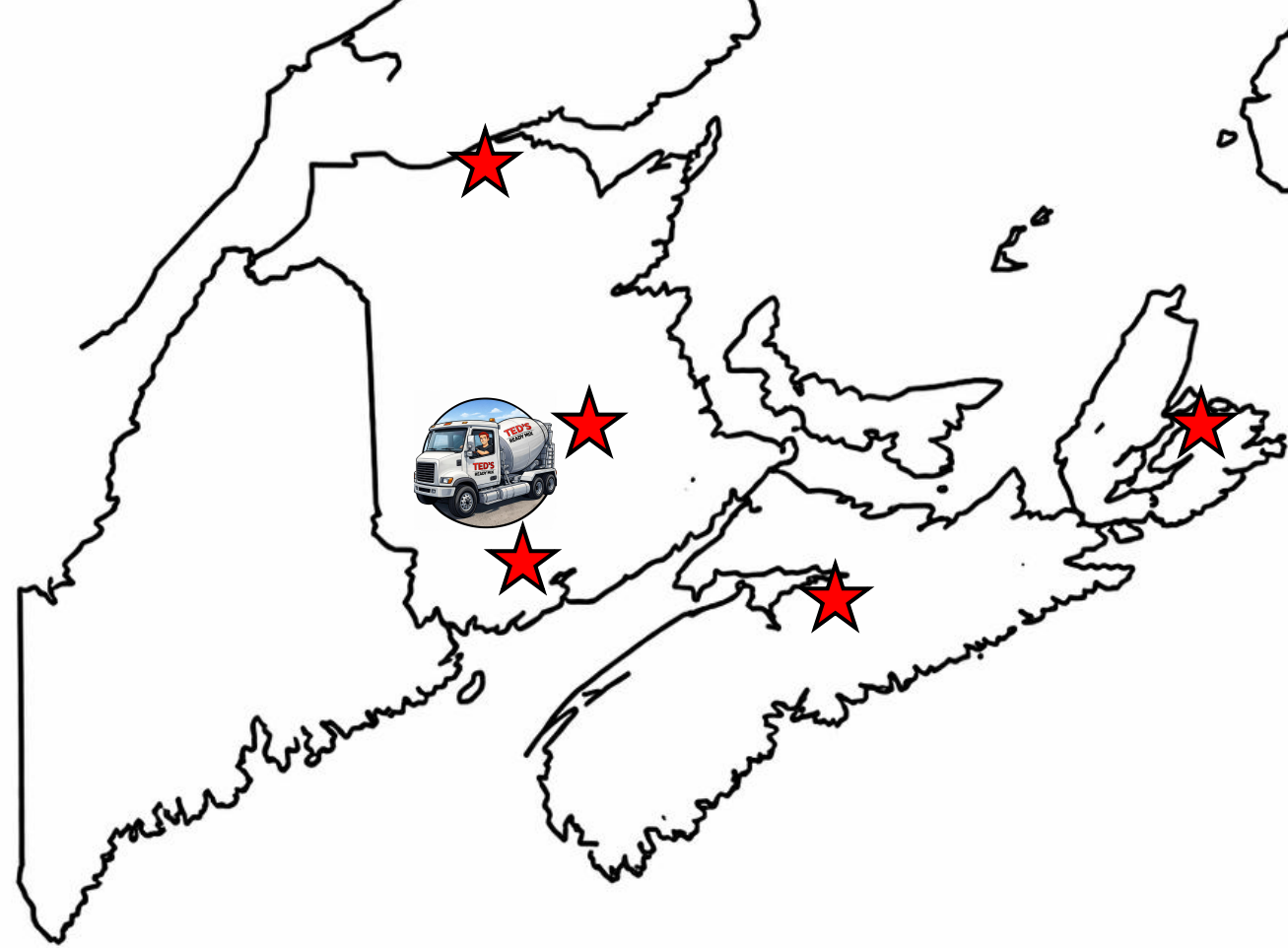
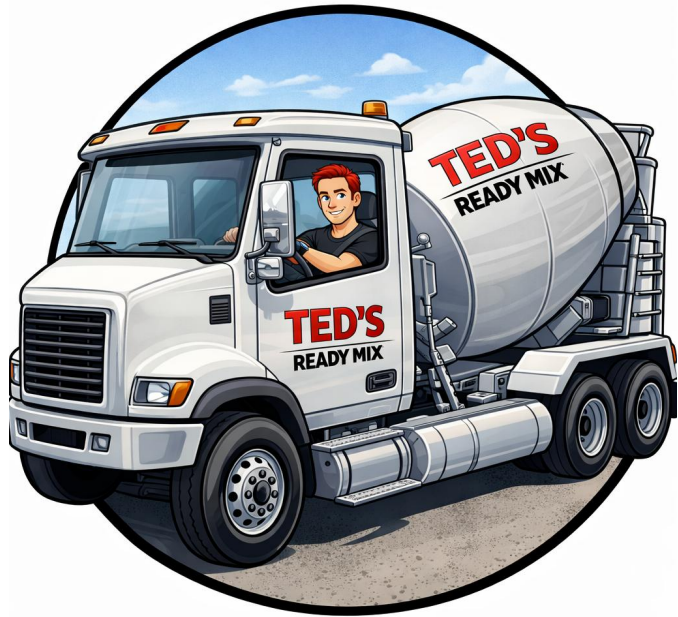
10 % of GGP

# HOW DO I KNOW IF MY MIX IS LOW CARBON?

Exposure Class: C-1 per CSA A23.1:24  
Compressive Strength: 35MPa at 56 Days

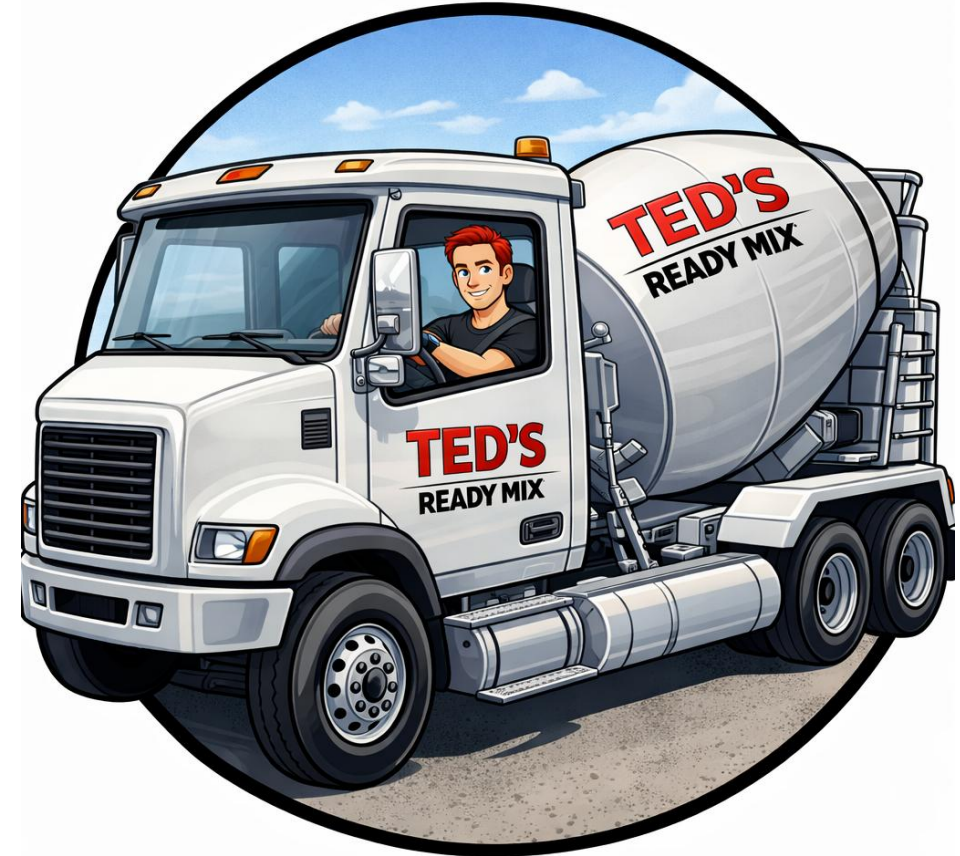


| Contents             | Mix Proportions        |
|----------------------|------------------------|
| GUL                  | 308 kg/m <sup>3</sup>  |
| Fly Ash              | 102 kg/m <sup>3</sup>  |
| Coarse Aggregate     | 1020 kg/m <sup>3</sup> |
| Fine Aggregate       | 678 kg/m <sup>3</sup>  |
| Water                | 160 kg/m <sup>3</sup>  |
| Air Entraining Admix | 250 mL/m <sup>3</sup>  |
| Water Reducing Admix | 650 mL/m <sup>3</sup>  |

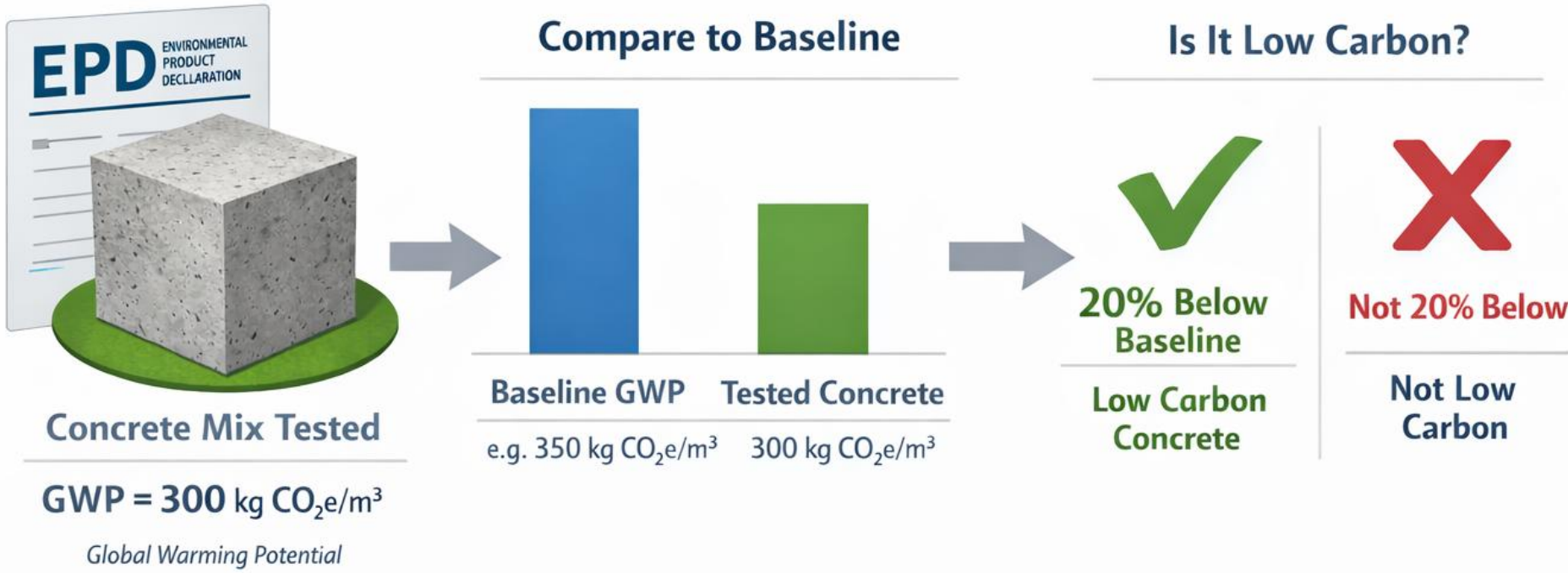


# HOW DO I KNOW IF MY MIX IS LOW CARBON?

- Concrete supplied to a job is considered low carbon when its **global warming potential (GWP)** is lower than a defined baseline.
- The GWP of a concrete mix is a measure of the greenhouse gas emissions associated with producing 1 m<sup>3</sup> of that concrete during the production stage.
- The GWP of a mix is determined by developing an Environmental Product Declaration (EPD)



# HOW DO I KNOW IF MY MIX IS LOW CARBON?



# WHAT ARE EPDs?

- An Environmental Product Declaration or EPD is a standardized, third party verified document.
- It reports environmental impacts of a mix design.
- It follows ISO 14025 and ISO 21930 and product category rules for concrete.
- It does not judge good or bad, it reports transparent data.
- Developed using Life Cycle Assessment Tools (usually by LCA companies)

## ENVIRONMENTAL IMPACTS

### Declared Product:

ConAtlantic 35MPa Mix Example  
Compressive strength: 35 MPa  
Compressive days: 56

### Declared Unit: 1 m<sup>3</sup> of concrete

|  |                   |
|--|-------------------|
| Global Warming Potential (kg CO <sub>2</sub> -eq)              | 306 (234)         |
| Ozone Depletion Potential (kg CFC-11-eq)                       | 7.04E-6 (5.38E-6) |
| Acidification Potential (kg SO <sub>2</sub> -eq)               | 1.03 (0.79)       |
| Eutrophication Potential (kg N-eq)                             | 0.12 (0.09)       |
| Photochemical Ozone Creation Potential (kg O <sub>3</sub> -eq) | 27.0 (20.7)       |
| Abiotic Depletion, non-fossil (kg Sb eq)                       | 8.00E-5 (6.12E-5) |
| Abiotic Depletion, fossil (MJ)                                 | 981 (750)         |
| Total Waste Disposed (kg)                                      | 2.36 (1.80)       |
| Consumption of Freshwater (m <sup>3</sup> )                    | 3.45 (2.64)       |

**Product Components:** crushed aggregate (ASTM C33), natural aggregate (ASTM C33), admixture (ASTM C494), portland limestone cement (ASTM 595), admixture (ASTM C260), batch water (ASTM C1602), fly ash (ASTM C618)

# READY MIX CONCRETE EPDs

| 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/ Demolition | 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

“Cradle to Gate”

# EPD INPUTS

## A1 Raw Material Supply

A1 covers the extraction and manufacturing of all constituent materials used to make the concrete.

## A2 Transport

Transportation of each material from its source to the ready-mix plant.

## A3 Manufacturing

Covers the batching and mixing of concrete at the ready-mix plant.

- Manufacturing energy and process emissions for cement, GUL, and supplementary cementing materials, including calcination, grinding, and blending
- Extraction and processing of aggregates, including quarrying, crushing, screening, washing, and on site equipment fuel use
- Production of chemical admixtures, including raw chemical inputs, manufacturing energy, and formulation emissions

# EPD INPUTS

## A1 Raw Material Supply

A1 covers the extraction and manufacturing of all constituent materials used to make the concrete.

## A2 Transport

Transportation of each material from its source to the ready-mix plant.

## A3 Manufacturing

Covers the batching and mixing of concrete at the ready-mix plant.

- Transportation of cement, fly ash, aggregates, admixtures, and other inputs from supplier locations to the ready mix plant
- Haul distances from each material source, based on actual supplier locations
- Transportation mode and vehicle type, typically heavy duty diesel trucks
- Fuel consumption and associated greenhouse gas emissions from material hauling

# EPD INPUTS

## A1 Raw Material Supply

A1 covers the extraction and manufacturing of all constituent materials used to make the concrete.

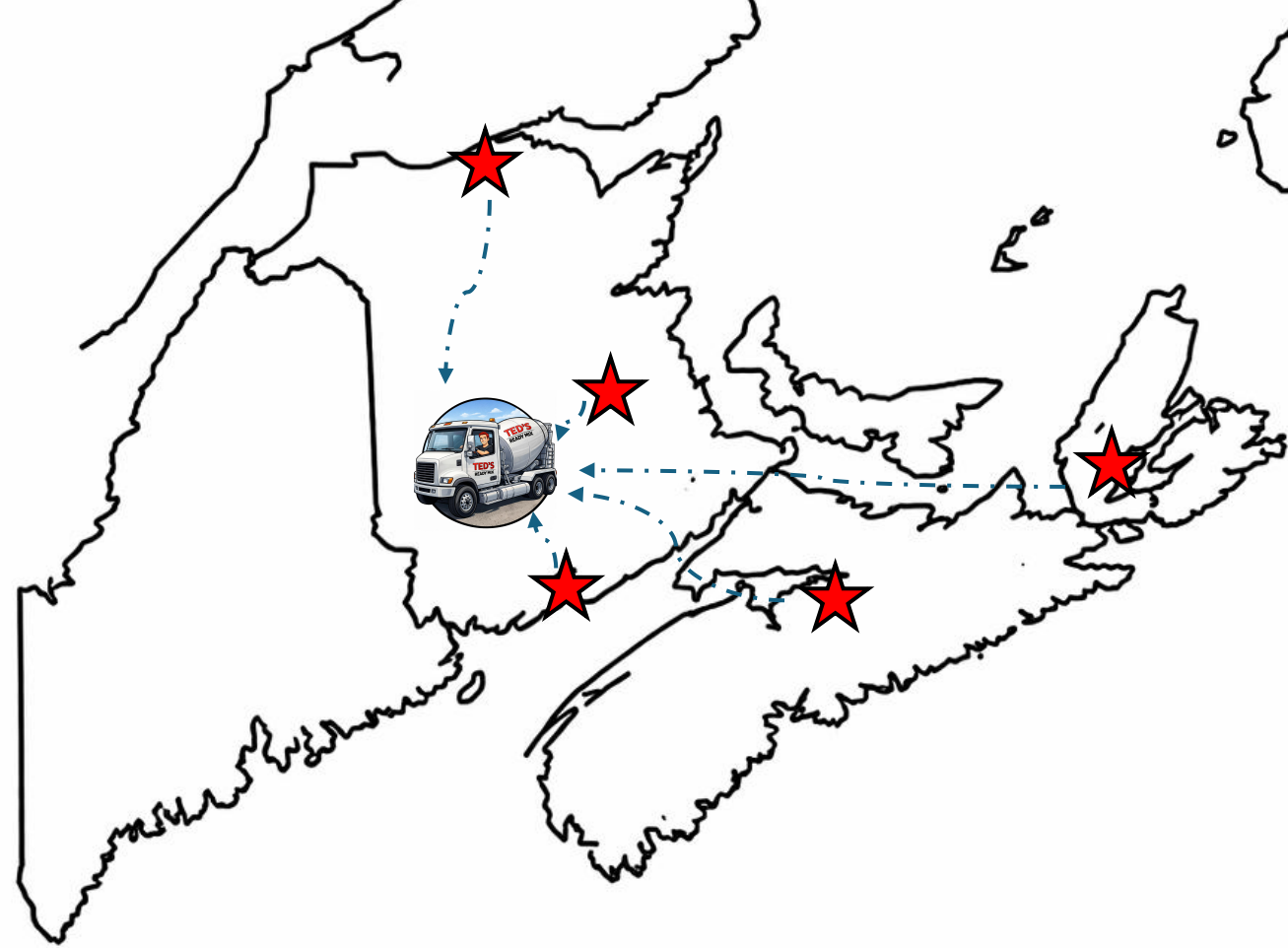
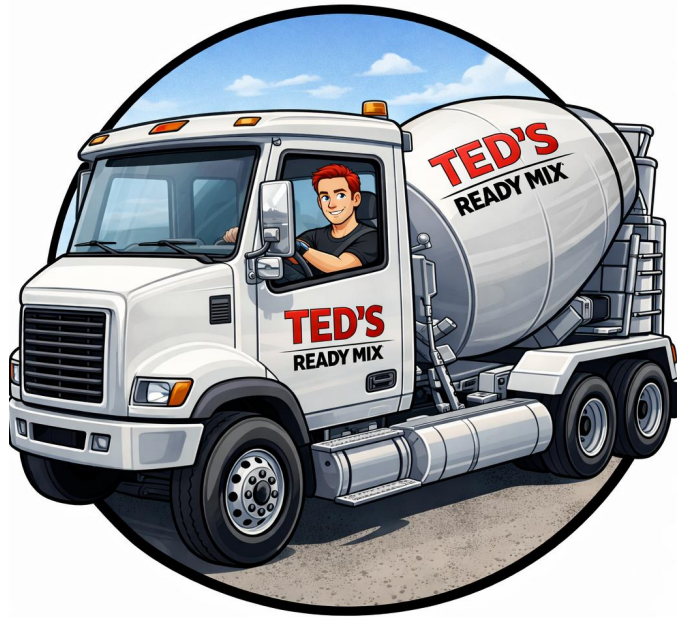
## A2 Transport

Transportation of each material from its source to the ready-mix plant.

## A3 Manufacturing

Covers the batching and mixing of concrete at the ready-mix plant.

- Electricity consumption for concrete batching, conveying, and plant operations
- Fuel use at the plant, such as loaders, heaters, or generators
- Water use at the plant, including mixing water and wash water management
- On site emissions associated with concrete production activities





### MIX DESIGN

| Material             | Per (M3) | Unit |
|----------------------|----------|------|
| GUL Cement           | 308      | kg   |
| Fly Ash              | 103      | kg   |
| 20mm Dexter          | 1,020    | kg   |
| Sand Aberdeen        | 678      | kg   |
| Batch Water          | 160      | l    |
| Master Air AE200     | 250      | ml   |
| Master Pozzolith 210 | 650      | ml   |

### COMPARISON TO REGIONAL AVERAGE

Concrete Canada Nova Scotia

|        |   |
|--------|---|
| 35 MPa | 422 kg CO <sub>2</sub> -eq/m <sup>3</sup> |
|--------|---|

When a mix strength falls between the reported strength values, the baseline GWP values displayed are calculated using linear interpolation. When a mix strength falls outside the reported strength values, the baseline GWP values displayed are calculated using linear forecasting. These baseline GWP values are based on the 'baseline' without air mix design results for each strength class, as reported in the seven regional Canadian industry-wide EPDs, issued on July 27, 2022.

### ENVIRONMENTAL IMPACTS

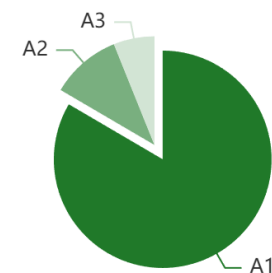
ConAtlantic 35MPa Mix Example  
 Compressive strength: 35 MPa  
 Compressive days: 56

Declared Unit: 1 m<sup>3</sup> of concrete

|  |                   |
|--|-------------------|
| Global Warming Potential (kg CO <sub>2</sub> -eq)              | 296 (226)         |
| Ozone Depletion Potential (kg CFC-11-eq)                       | 6.81E-6 (5.21E-6) |
| Acidification Potential (kg SO <sub>2</sub> -eq)               | 1.01 (0.77)       |
| Eutrophication Potential (kg N-eq)                             | 0.11 (0.09)       |
| Photochemical Ozone Creation Potential (kg O <sub>3</sub> -eq) | 26.4 (20.2)       |
| Abiotic Depletion, non-fossil (kg Sb eq)                       | 7.62E-5 (5.83E-5) |
| Abiotic Depletion, fossil (MJ)                                 | 959 (733)         |
| Total Waste Disposed (kg)                                      | 2.22 (1.70)       |
| Consumption of Freshwater (m <sup>3</sup> )                    | 3.40 (2.60)       |

**Product Components:** crushed aggregate (ASTM C33), natural aggregate (ASTM C33), admixture (ASTM C494), portland limestone cement (ASTM 595), admixture (ASTM C260), batch water (ASTM C1602), fly ash (ASTM C618)

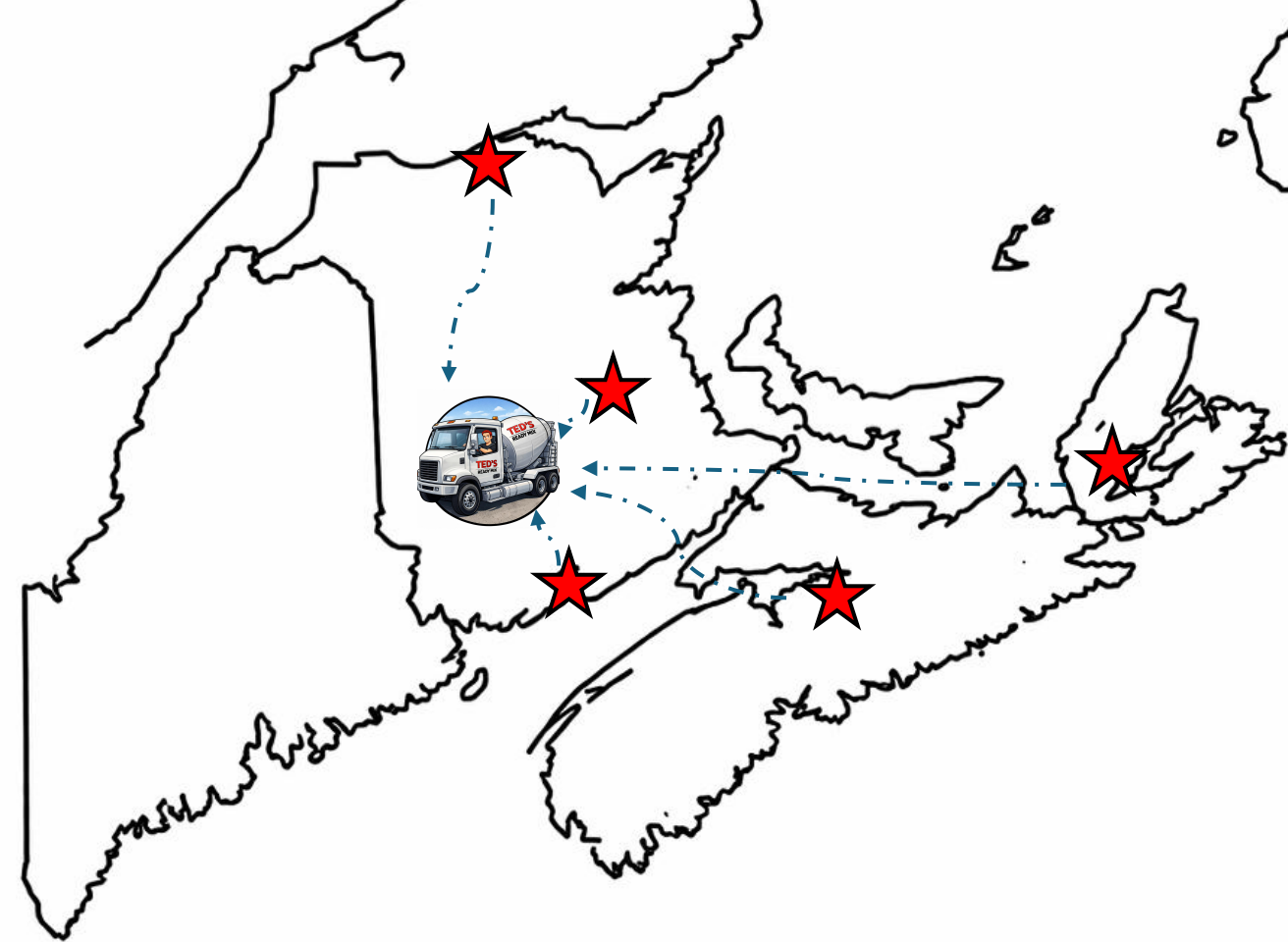
GWP = 296 kg/CO<sub>2</sub>-eq



|                         |       | GWP (kg CO <sub>2</sub> -eq) |      |                            |                |               |
|-------------------------|-------|------------------------------|------|----------------------------|----------------|---------------|
|                         |       | Qty. per m <sup>3</sup>      | UoM  | Material (A1)              | Transport (A2) | Total (A1-A2) |
| <i>A.E.A.</i>           | 250   | ml                           | 0.91 | 0.15                       | 1.07           |               |
|                         | 650   | ml                           | 2.37 | 0.40                       | 2.77           |               |
| <i>W.R.A.</i>           | 1,020 | kg                           | 7.98 | 4.54                       | 12.5           |               |
|                         | 678   | kg                           | 2.41 | 11.6                       | 14.0           |               |
| <i>Coarse Aggregate</i> |       |                              |      |                            |                |               |
| <i>Fine Aggregate</i>   |       |                              |      |                            |                |               |
| <i>Water</i>            | 160   | l                            | 0.05 | 0                          | 0.05           |               |
| <i>GUL</i>              | 308   | kg                           | 233  | 9.90                       | 243            |               |
| <i>Fly Ash</i>          | 103   | kg                           | 0    | 4.35                       | 4.35           |               |
|                         |       |                              |      | <b>247</b>                 | <b>31.0</b>    | <b>278</b>    |
|                         |       |                              |      | <b>Manufacturing (A3):</b> |                | <b>17.8</b>   |
|                         |       |                              |      | <b>Total (A1-A3):</b>      |                | <b>296</b>    |

**GWP = 312 kg/CO<sub>2</sub>-eq**

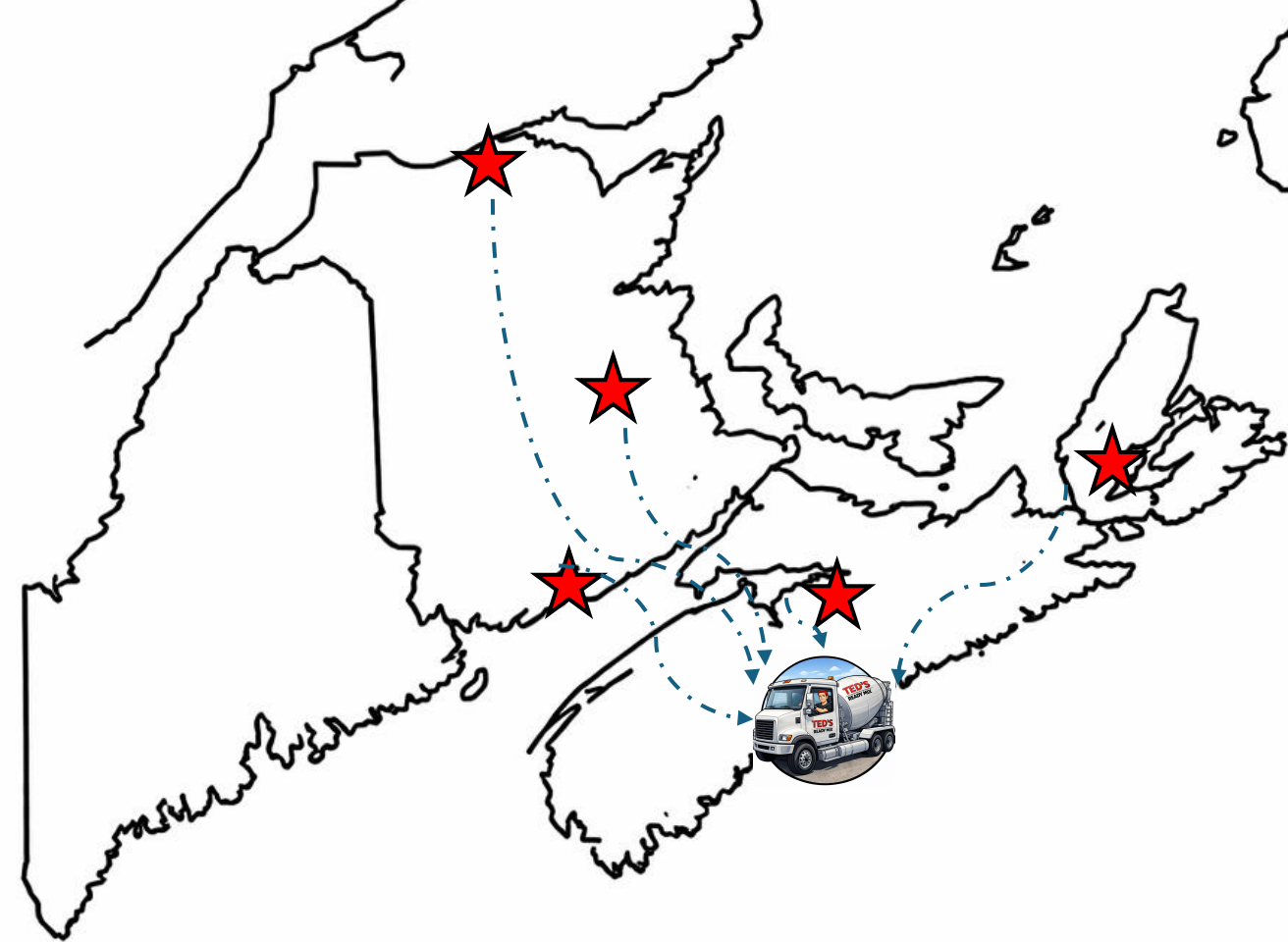
| Contents             | Mix Proportions        |
|----------------------|------------------------|
| GUL                  | 308 kg/m <sup>3</sup>  |
| Fly Ash              | 102 kg/m <sup>3</sup>  |
| Coarse Aggregate     | 1020 kg/m <sup>3</sup> |
| Fine Aggregate       | 678 kg/m <sup>3</sup>  |
| Water                | 160 kg/m <sup>3</sup>  |
| Air Entraining Admix | 250 mL/m <sup>3</sup>  |
| Water Reducing Admix | 650 mL/m <sup>3</sup>  |



Ready Mix Plant: Fredericton, N.B.

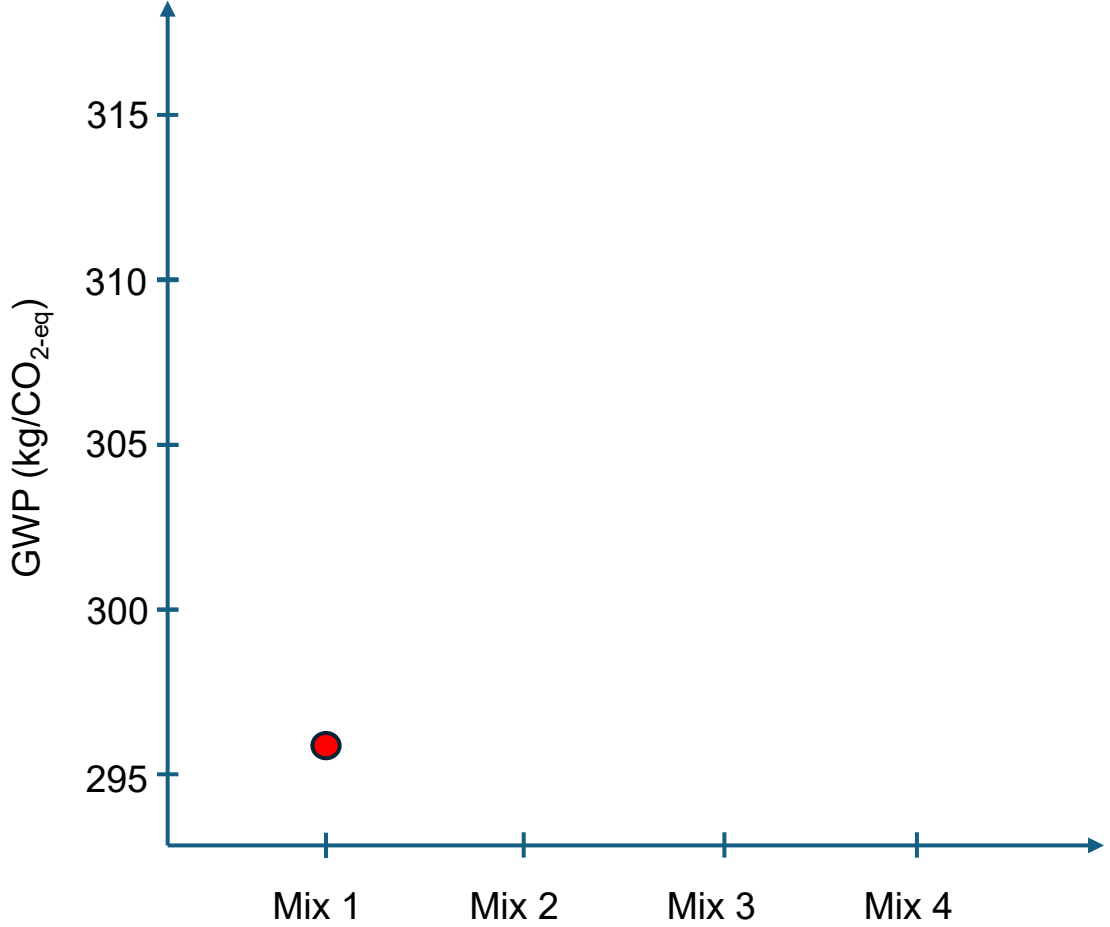
**GWP = 296 kg/CO<sub>2</sub>-eq**

| Contents             | Mix Proportions        |
|----------------------|------------------------|
| GUL                  | 308 kg/m <sup>3</sup>  |
| Fly Ash              | 102 kg/m <sup>3</sup>  |
| Coarse Aggregate     | 1020 kg/m <sup>3</sup> |
| Fine Aggregate       | 678 kg/m <sup>3</sup>  |
| Water                | 160 kg/m <sup>3</sup>  |
| Air Entraining Admix | 250 mL/m <sup>3</sup>  |
| Water Reducing Admix | 650 mL/m <sup>3</sup>  |

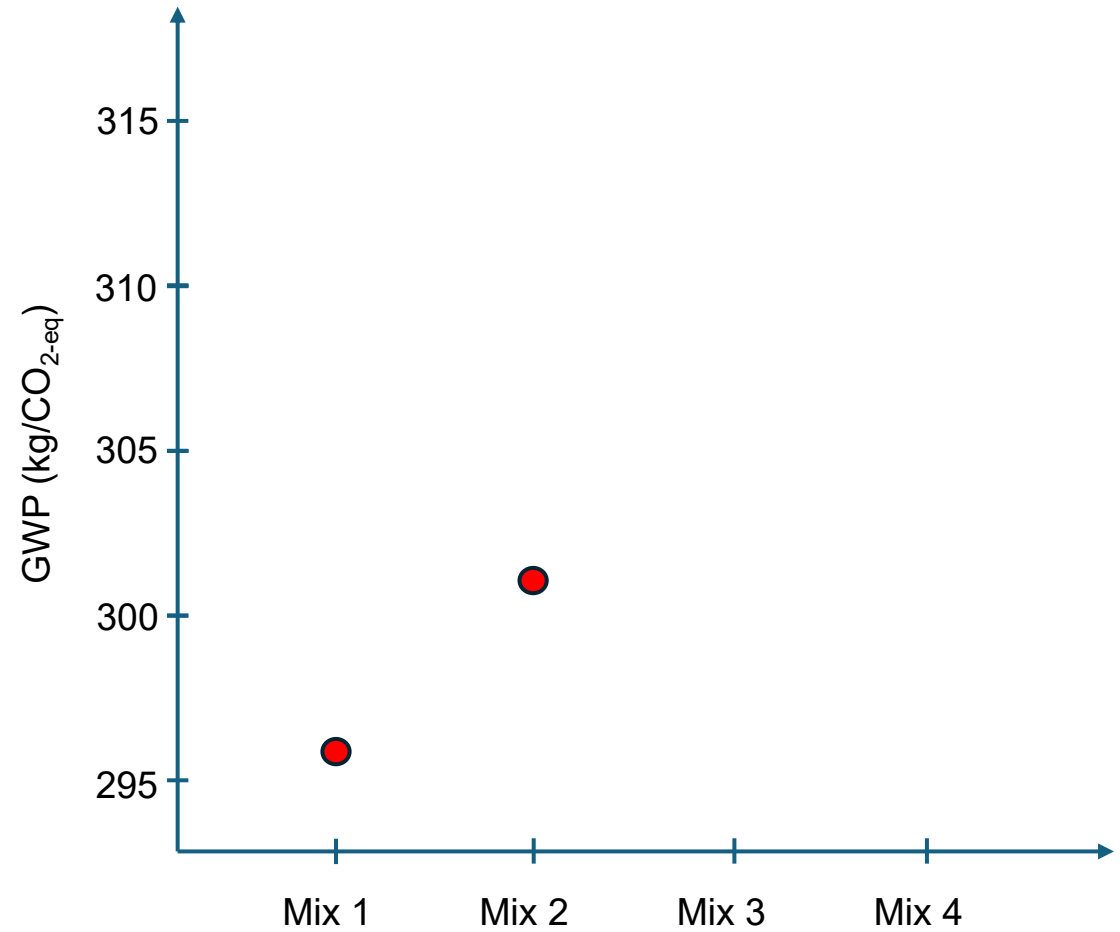


Ready Mix Plant: Halifax, N.S.

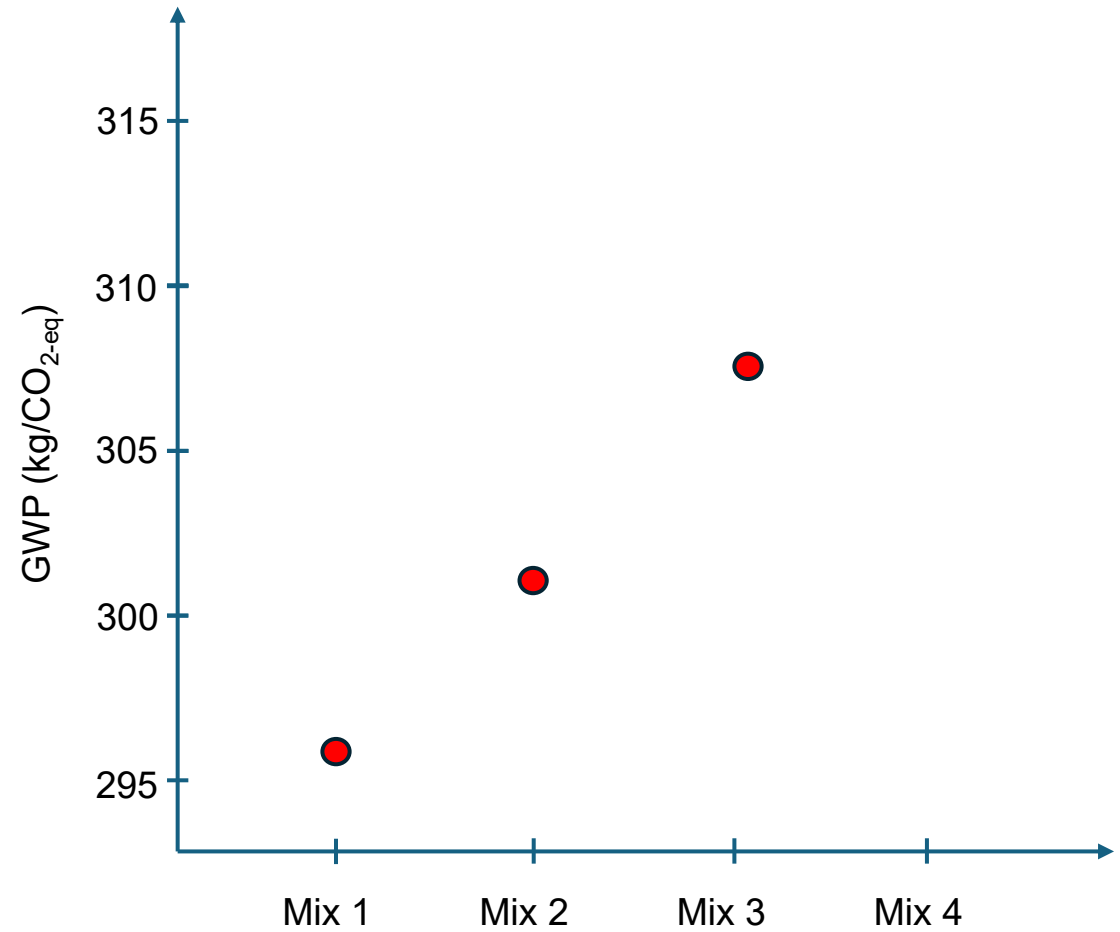
| Content                                | Mix 1      | Mix 2 | Mix 3 | Mix 4 |
|--|------------|-------|-------|-------|
| <b>Total Cement (kg/m<sup>3</sup>)</b> | <b>410</b> |       |       |       |
| GUL (kg/m <sup>3</sup> )               | 308        |       |       |       |
| Fly Ash (kg/m <sup>3</sup> )           | 102        |       |       |       |
| Coarse (20mm) (kg/m <sup>3</sup> )     | 1020       |       |       |       |
| Fine (kg/m <sup>3</sup> )              | 678        |       |       |       |
| Water (kg/m <sup>3</sup> )             | 160        |       |       |       |
| A.E.A. (mL/m <sup>3</sup> )            | 250        |       |       |       |
| W.R.A. (mL/m <sup>3</sup> )            | 650        |       |       |       |
| <b>GWP (kg/CO<sub>2</sub>-eq)</b>      | <b>296</b> |       |       |       |



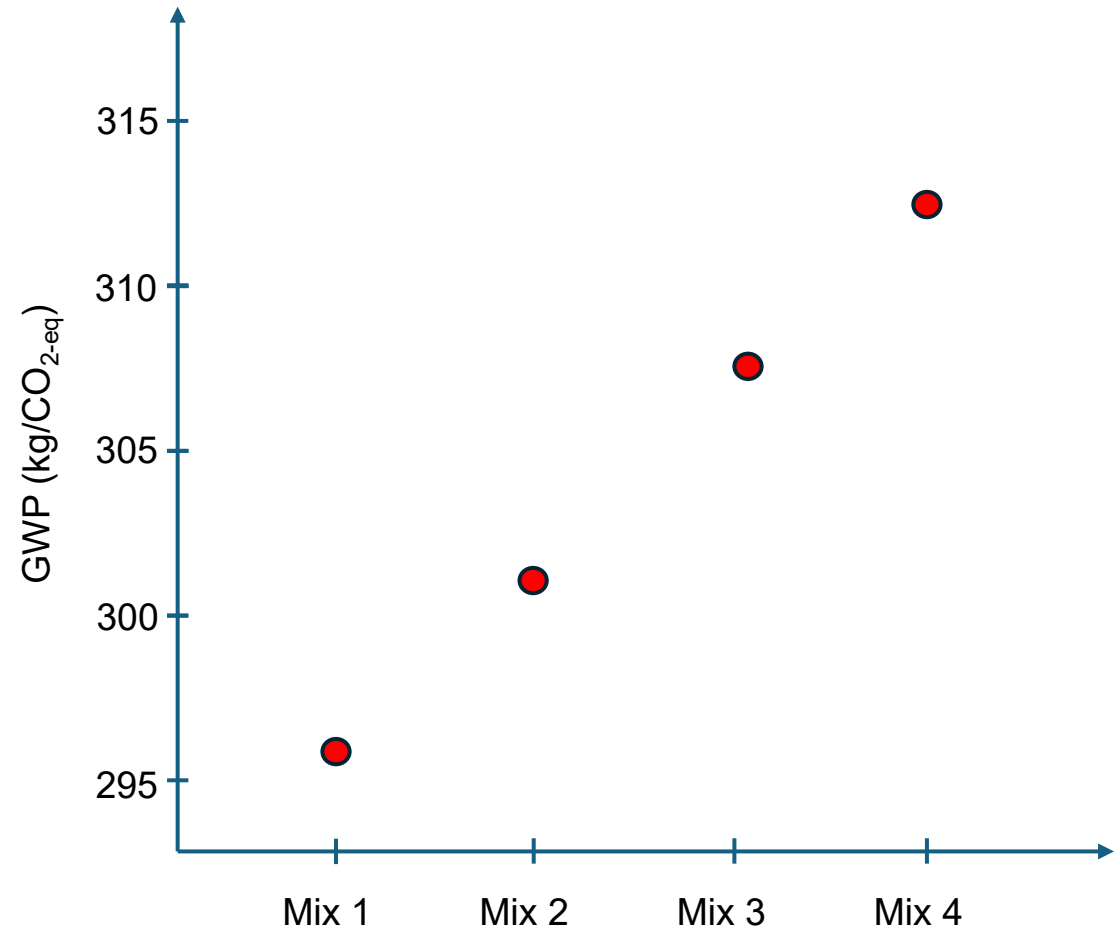
| Content                                | Mix 1      | Mix 2      | Mix 3 | Mix 4 |
|--|------------|------------|-------|-------|
| <b>Total Cement (kg/m<sup>3</sup>)</b> | <b>410</b> | <b>420</b> |       |       |
| GUL (kg/m <sup>3</sup> )               | 308        | 315        |       |       |
| Fly Ash (kg/m <sup>3</sup> )           | 102        | 105        |       |       |
| Coarse (20mm) (kg/m <sup>3</sup> )     | 1020       | 1020       |       |       |
| Fine (kg/m <sup>3</sup> )              | 678        | 670        |       |       |
| Water (kg/m <sup>3</sup> )             | 160        | 160        |       |       |
| A.E.A. (mL/m <sup>3</sup> )            | 250        | 250        |       |       |
| W.R.A. (mL/m <sup>3</sup> )            | 650        | 650        |       |       |
| <b>GWP (kg/CO<sub>2</sub>-eq)</b>      | <b>296</b> | <b>301</b> |       |       |



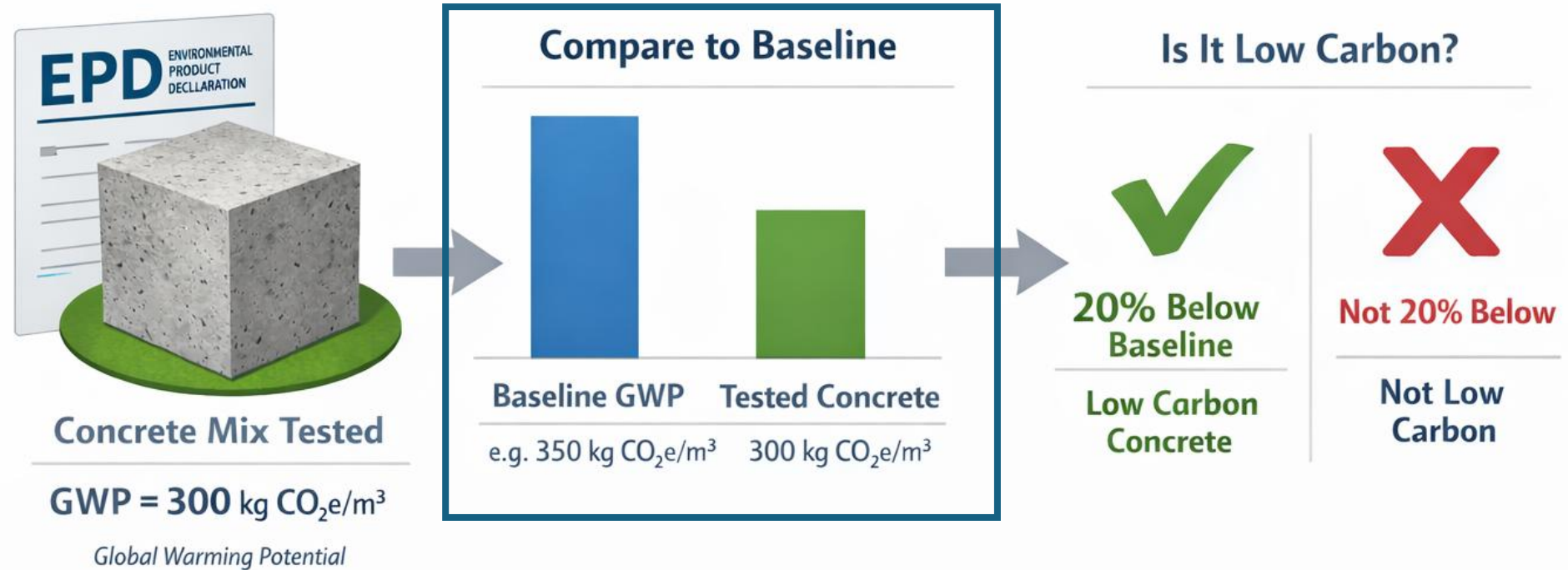
| Content                                | Mix 1      | Mix 2      | Mix 3      | Mix 4 |
|--|------------|------------|------------|-------|
| <b>Total Cement (kg/m<sup>3</sup>)</b> | <b>410</b> | <b>420</b> | <b>430</b> |       |
| GUL (kg/m <sup>3</sup> )               | 308        | 315        | 323        |       |
| Fly Ash (kg/m <sup>3</sup> )           | 102        | 105        | 108        |       |
| Coarse (20mm) (kg/m <sup>3</sup> )     | 1020       | 1020       | 1020       |       |
| Fine (kg/m <sup>3</sup> )              | 678        | 670        | 659        |       |
| Water (kg/m <sup>3</sup> )             | 160        | 160        | 160        |       |
| A.E.A. (mL/m <sup>3</sup> )            | 250        | 250        | 250        |       |
| W.R.A. (mL/m <sup>3</sup> )            | 650        | 650        | 650        |       |
| <b>GWP (kg/CO<sub>2</sub>-eq)</b>      | <b>296</b> | <b>301</b> | <b>308</b> |       |



| Content                                | Mix 1      | Mix 2      | Mix 3      | Mix 4      |
|--|------------|------------|------------|------------|
| <b>Total Cement (kg/m<sup>3</sup>)</b> | <b>410</b> | <b>420</b> | <b>430</b> | <b>440</b> |
| GUL (kg/m <sup>3</sup> )               | 308        | 315        | 323        | 330        |
| Fly Ash (kg/m <sup>3</sup> )           | 102        | 105        | 108        | 110        |
| Coarse 1 (20mm) (kg/m <sup>3</sup> )   | 1020       | 1020       | 1020       | 1020       |
| Fine (kg/m <sup>3</sup> )              | 678        | 670        | 659        | 652        |
| Water (kg/m <sup>3</sup> )             | 160        | 160        | 160        | 160        |
| A.E.A. (mL/m <sup>3</sup> )            | 250        | 250        | 250        | 250        |
| W.R.A. (mL/m <sup>3</sup> )            | 650        | 650        | 650        | 650        |
| <b>GWP (kg/CO<sub>2</sub>-eq)</b>      | <b>296</b> | <b>301</b> | <b>308</b> | <b>313</b> |

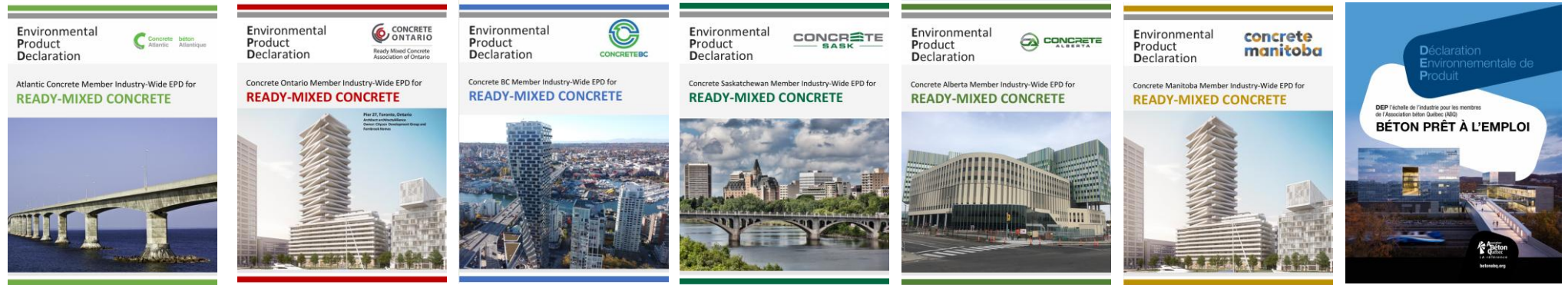


# HOW DO I KNOW IF MY MIX IS LOW CARBON?



# BASELINE EPDs

## Ready Mix Concrete (CRMCA)



## Precast Concrete (CPCI)



# REGIONAL BASELINE EPDs



- Represents data for an average ready-mix concrete plant in Atlantic Canada
- 20-60MPa
- Fly Ash – 0 to 40%
- Range of aggregates and admixtures
- Valid for 5 years (expires July 2027)

Available online:  
[CRMCA EPD Atlantic 20220729.pdf](#)  
([atlanticconcrete.ca](http://atlanticconcrete.ca))

# BASELINE EPD



## 18 Mixture Classes:

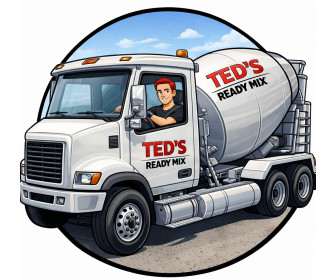
- 20 MPa without air
- 20 MPa with air
- 25 MPa without air
- 25 MPa with air
- 25 MPa with air & 0.55 w/cm (C-4, F-2)
- 30 MPa without air
- 30 MPa with air
- 32 MPa with air & 0.45 w/cm (C-2)
- 35 MPa without air
- 35 MPa with air
- 35 MPa with air & 0.40 w/cm (C-1)
- 40 MPa without air
- 40 MPa with air
- 45 MPa without air
- 45 MPa with air
- 50 MPa without air
- 50 MPa with air
- 60 MPa without air

# BASELINE EPD



## 18 Mixture Classes:

- 20 MPa without air
- 20 MPa with air
- 25 MPa without air
- 25 MPa with air
- 25 MPa with air & 0.55 w/cm (C-4, F-2)
- 30 MPa without air
- 30 MPa with air
- 32 MPa with air & 0.45 w/cm (C-2)
- 35 MPa without air
- 35 MPa with air
- **35 MPa with air & 0.40 w/cm (C-1)**
- 40 MPa without air
- 40 MPa with air
- 45 MPa without air
- 45 MPa with air
- 50 MPa without air
- 50 MPa with air
- 60 MPa without air



**Table 15. LCA Results 35 MPa concrete with air & 0.40 w/cm (C-1)**

| Unit                               | Baseline 35 MPa concrete with air & 0.40 w/cm (C-1) GU 10 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GU | 35 MPa concrete with air & 0.40 w/cm (C-1) GU 10 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GU 20 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GU 30 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GU 40 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GUL | 35 MPa concrete with air & 0.40 w/cm (C-1) GUL 10 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GUL 20 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GUL 30 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GUL 40 FA |          |
|------------------------------------|--|---|---|---|---|---|--|--|--|--|--|----------|
| <b>Environmental impacts</b>       |  |   |   |   |   |   |  |  |  |  |  |          |
| GWP                                | kg CO <sub>2</sub> eq.                                       | 474.24  | 516.26  | 474.24  | 432.21  | 390.18  | 348.15   | 477.93   | 439.74   | 401.54   | 363.35   | 325.15   |
| ODP                                | kg CFC-11 eq.  | 9.30E-06                                      | 1.02E-05  | 9.30E-06  | 8.35E-06  | 7.40E-06  | 6.45E-06                                       | 9.62E-06   | 8.73E-06   | 7.85E-06   | 6.96E-06   | 6.07E-06 |
| EP                                 | kg N eq.   | 0.43  | 0.46  | 0.43  | 0.39  | 0.36  | 0.32   | 0.45   | 0.41   | 0.38   | 0.34   | 0.31     |
| AP                                 | kg SO <sub>2</sub> eq.                                       | 1.95  | 2.01  | 1.95  | 1.89  | 1.83  | 1.77   | 1.96   | 1.91   | 1.86   | 1.80   | 1.75     |
| POCP                               | kg O <sub>3</sub> eq.  | 44.59   | 45.24   | 44.59   | 43.94   | 43.29   | 42.64  | 44.66  | 44.07  | 43.47  | 42.88  | 42.29    |
| <b>Use of primary resources</b>    |  |   |   |   |   |   |  |  |  |  |  |          |
| RPR <sub>F</sub>                   | MJ, NCV  | 153.64  | 168.49  | 153.64  | 138.80  | 123.96  | 109.12   | 165.46   | 150.92   | 136.38   | 121.84   | 107.30   |
| RPR <sub>M</sub>                   | MJ, NCV  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| NRPR <sub>F</sub>                  | MJ, NCV  | 2402.13                                       | 2510.83   | 2402.13   | 2293.44   | 2184.74   | 2076.05  | 2172.33  | 2097.49  | 2022.64  | 1947.80  | 1872.95  |
| NRPR <sub>M</sub>                  | MJ, NCV  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| <b>Use of secondary resources</b>  |  |   |   |   |   |   |  |  |  |  |  |          |
| SM                                 | kg   | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| RSF                                | MJ, NCV  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| NRSF                               | MJ, NCV  | 257.42  | 286.02  | 257.42  | 228.82  | 200.21  | 171.61   | 258.36   | 232.53   | 206.69   | 180.85   | 155.02   |
| RE                                 | MJ, NCV  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| <b>Abiotic depletion potential</b> |  |   |   |   |   |   |  |  |  |  |  |          |
| ADPF                               | MJ, LHV  | 1306.36                                       | 1307.21   | 1306.36   | 1305.51   | 1304.66   | 1303.81  | 1288.48  | 1289.50  | 1290.53  | 1291.55  | 1292.57  |

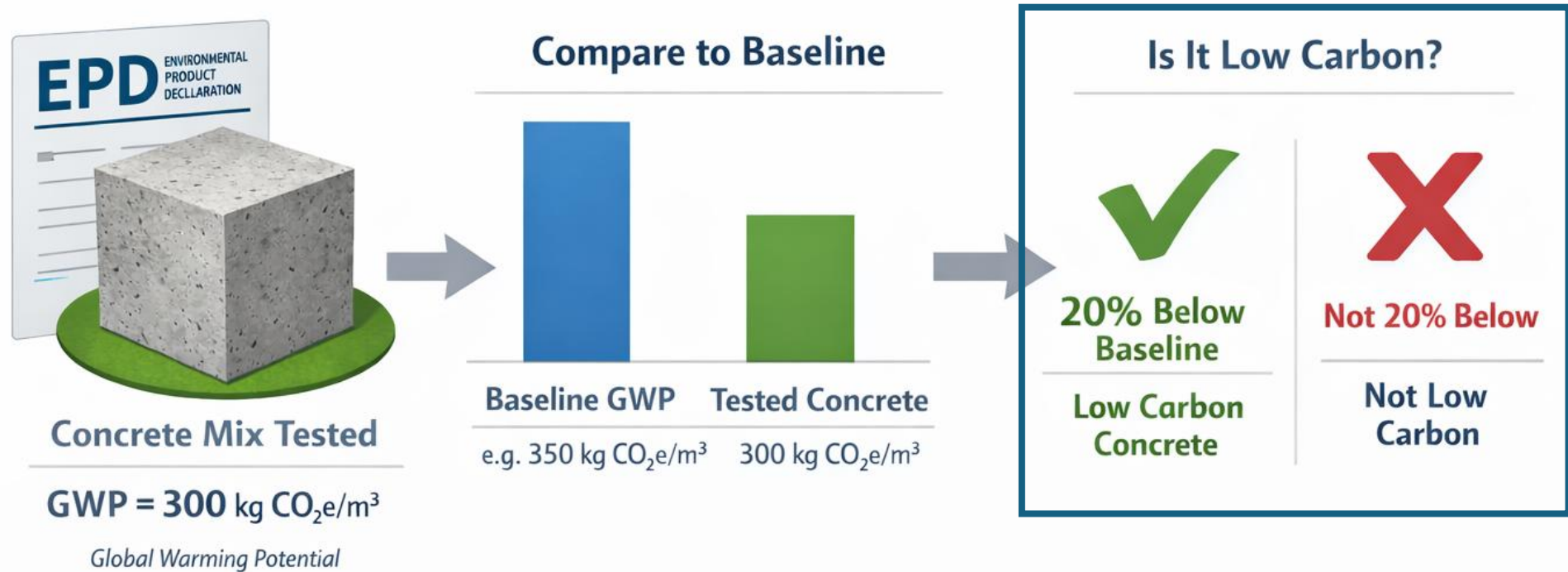
**Table 15. LCA Results 35 MPa concrete with air & 0.40 w/cm (C-1)**

| Unit                       | Baseline 35 MPa concrete with air & 0.40 w/cm (C-1) GU 10 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GU | 35 MPa concrete with air & 0.40 w/cm (C-1) GU 10 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GU 20 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GU 30 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GU 40 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GUL | 35 MPa concrete with air & 0.40 w/cm (C-1) GUL 10 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GUL 20 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GUL 30 FA | 35 MPa concrete with air & 0.40 w/cm (C-1) GUL 40 FA |
|----------------------------|--|---|---|---|---|---|--|--|--|--|--|
| Environmental impacts      |  |   |   |   |   |   |  |  |  |  |  |
| GWP kg CO <sub>2</sub> eq. | 474.24   | 516.26  | 474.24  | 432.21  | 390.18  | 348.15  | 477.93   | 439.74   | 401.54   | 363.35   | 325.15   |

Atlantic Canada Regional Industry Average  
 Concrete for a given strength and exposure class is typically:

- Type GU Cement
- 10-20% Fly Ash Use

# HOW DO I KNOW IF MY MIX IS LOW CARBON?



# SPECIFICATION EXAMPLE

*“Achieve a minimum 15% reduction in project wide concrete global warming potential (GWP) compared to the Atlantic Canada baseline Environmental Product Declaration (EPD) document.*

*The concrete supplier shall provide Type III Environmental Product Declarations for all concrete mixtures supplied to the project.*

*The Contractor shall document the overall global warming potential reduction using the Concrete Carbon Project Budget method.”*

# Government of Canada Standard on Embodied Carbon in Construction

- Federally funded major projects must disclose the embodied carbon of ready mixed concrete using verified Environmental Product Declarations
- Total project greenhouse gas emissions from ready mixed concrete must be at least 10% lower than those calculated using Regional Industry Average EPD values for each concrete strength class and supplied volume

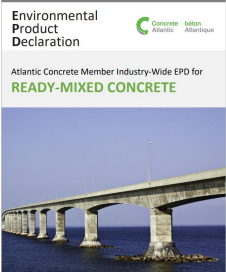
Effective Date: December 31, 2022  
For projects or programs at or above \$5 million  
Minimum Material Quantity: 100m<sup>3</sup>

The screenshot shows the official Government of Canada website page for the 'Standard on Embodied Carbon in Construction'. The page header includes the Government of Canada logo and a search bar. The main content area features a breadcrumb trail: 'Canada.ca > How government works > Policies, directives, standards and guidelines'. The title is 'Standard on Embodied Carbon in Construction', followed by a brief description: 'The objective of this standard is to establish requirements to disclose and reduce the embodied carbon footprint of construction projects in accordance with the commitments in the *Greening Government Strategy*.' The date modified is '2025-03-20'. Below the description are two sets of 'Expand all' and 'Collapse all' buttons. The main content is organized into a list of sections, each with a right-pointing arrow: '1. Preamble', '2. Effective date', '3. Standards', '4. Application', '5. References', '6. Enquiries', 'Appendix A: embodied carbon design estimates and reductions', 'Appendix B: structural material embodied carbon disclosures and reductions', and 'Appendix C: About Exemption Rationales'. On the right side, there is a 'More information' section with links for 'Hierarchy' and 'Archives', and buttons for 'Print-friendly' and 'XML'.

# CONCRETE CARBON PROJECT BUDGET (CCPB)



**CONCRETE  
CARBON**



*Carbon Budgets for Concrete*

| Application | Strength (MPa) | Exposure Class | Max. GWP (kg CO <sub>2</sub> /m <sup>3</sup> ) |
|-------------|----------------|----------------|--|
| Footings    | 25             | N              | 354.02   |
| Slabs       | 30             | N              | 379.12   |
| Columns     | 35             | N              | 422.25   |
| Exterior    | 32             | C2             | 438.78   |



DON'T enforce limits at the individual mix design level

# Environmental Product Declaration



Atlantic Concrete Member Industry-Wide EPD for **READY-MIXED CONCRETE**



**Table 12. LCA Results 32 MPa concrete with air & 0.45 w/cm (C-2)**

| Unit  | Baseline 32 MPa concrete with air & 0.45 w/cm (C-2) GU 10 FA | 32 MPa concrete with air & 0.45 w/cm (C-2) GU 10 FA | 32 MPa concrete with air & 0.45 w/cm (C-2) GU 10 FA | 32 MPa concrete with air & 0.45 w/cm (C-2) GU 20 FA | 32 MPa concrete with air & 0.45 w/cm (C-2) GU 30 FA | 32 MPa concrete with air & 0.45 w/cm (C-2) GU 40 FA | 32 MPa concrete with air & 0.45 w/cm (C-2) GUL 10 FA | 32 MPa concrete with air & 0.45 w/cm (C-2) GUL 20 FA | 32 MPa concrete with air & 0.45 w/cm (C-2) GUL 30 FA | 32 MPa concrete with air & 0.45 w/cm (C-2) GUL 40 FA |          |
|---|--|---|---|---|---|---|--|--|--|--|----------|
| <b>Environmental impacts</b>                            |  |   |   |   |   |   |  |  |  |  |          |
| GWP   | kg CO <sub>2</sub> eq.                                       | 438.78  | 477.15  | 438.78  | 400.40  | 362.03  | 323.66   | 442.15   | 407.28   | 372.40   | 302.66   |
| ODP   | kg CFC-11 eq.  | 8.56E-06  | 9.43E-06  | 8.56E-06  | 7.70E-06  | 6.83E-06  | 5.97E-06   | 8.86E-06   | 8.05E-06   | 7.24E-06   | 5.62E-06 |
| EP  | kg N eq.   | 0.40  | 0.43  | 0.40  | 0.36  | 0.33  | 0.30   | 0.42   | 0.38   | 0.35   | 0.32     |
| AP  | kg SO <sub>2</sub> eq.                                       | 1.90  | 1.95  | 1.90  | 1.84  | 1.79  | 1.74   | 1.91   | 1.86   | 1.81   | 1.76     |
| POCP  | kg O <sub>3</sub> eq.  | 44.05   | 44.64   | 44.05   | 43.45   | 42.86   | 42.26  | 44.11  | 43.57  | 43.03  | 42.48    |
| <b>Use of primary resources</b>                         |  |   |   |   |   |   |  |  |  |  |          |
| RPR <sub>F</sub>  | MJ, NCV  | 141.35  | 154.90  | 141.35  | 127.80  | 114.24  | 100.69   | 152.14   | 138.86   | 125.59   | 99.03    |
| RPR <sub>M</sub>  | MJ, NCV  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| NRPR <sub>F</sub>                                       | MJ, NCV  | 2275.15   | 2374.39   | 2275.15   | 2175.90   | 2076.66   | 1977.42  | 2065.33  | 1996.99  | 1928.66  | 1791.98  |
| NRPR <sub>M</sub>                                       | MJ, NCV  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| <b>Use of secondary resources</b>                       |  |   |   |   |   |   |  |  |  |  |          |
| SM  | kg   | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| RSF   | MJ, NCV  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| NRSF  | MJ, NCV  | 235.03  | 261.15  | 235.03  | 208.92  | 182.80  | 156.69   | 235.90   | 212.31   | 188.72   | 141.54   |
| RE  | MJ, NCV  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| <b>Abiotic depletion potential</b>                      |  |   |   |   |   |   |  |  |  |  |          |
| ADPF  | MJ, LHV  | 1266.02   | 1266.79   | 1266.02   | 1265.24   | 1264.47   | 1263.69  | 1249.69  | 1250.63  | 1251.56  | 1253.43  |
| ADPe  | kg Sb  | 1.49E-04  | 1.53E-04  | 1.49E-04  | 1.44E-04  | 1.40E-04  | 1.36E-04   | 1.52E-04   | 1.48E-04   | 1.43E-04   | 1.39E-04 |
| <b>Consumption of freshwater resources</b>              |  |   |   |   |   |   |  |  |  |  |          |
| FW  | m <sup>3</sup>   | 2.13  | 2.18  | 2.13  | 2.09  | 2.05  | 2.01   | 2.14   | 2.10   | 2.07   | 1.99     |
| <b>Waste and output flows</b>                           |  |   |   |   |   |   |  |  |  |  |          |
| HWD   | kg   | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02   | 0.02   | 0.02   | 0.02   | 0.02     |
| NHWD  | kg   | 19.20   | 21.33   | 19.20   | 17.07   | 14.94   | 12.81  | 19.26  | 17.34  | 15.42  | 11.57    |
| HLRW  | m <sup>3</sup>   | 1.72E-07  | 1.72E-07  | 1.72E-07  | 1.72E-07  | 1.72E-07  | 1.72E-07   | 1.72E-07   | 1.72E-07   | 1.72E-07   | 1.72E-07 |
| ILLRW   | m <sup>3</sup>   | 1.97E-07  | 1.97E-07  | 1.97E-07  | 1.97E-07  | 1.97E-07  | 1.97E-07   | 1.97E-07   | 1.97E-07   | 1.97E-07   | 1.97E-07 |
| CRU   | kg   | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| MR  | kg   | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| MER   | kg   | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| EE  | kg   | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00   | 0.00   | 0.00   | 0.00   | 0.00     |
| <b>Additional inventory parameters for transparency</b> |  |   |   |   |   |   |  |  |  |  |          |
| CCE   | kg CO <sub>2</sub> eq.                                       | 187.25  | 208.06  | 187.25  | 166.45  | 145.64  | 124.83   | 187.65   | 168.89   | 150.12   | 112.59   |



# CONCRETE CARBON PROJECT BUDGET (CCPB)



**CONCRETE CARBON**

A GUIDELINE FOR SPECIFYING  
LOW CARBON READY MIXED CONCRETE  
IN CANADA



NOVEMBER 2025



## Carbon Budgets for Concrete

| Application | Strength (MPa) | Exposure Class | Max. GWP (kg CO <sub>2</sub> /m <sup>3</sup> ) |
|-------------|----------------|----------------|--|
| Footings    | 25             | N              | 354.02   |
| Slabs       | 30             | N              | 379.12   |
| Columns     | 35             | N              | 422.25   |
| Exterior    | 32             | C2             | 438.78   |

X  
X  
X  
X

| Est. Volume (m <sup>3</sup> ) | Total GWP (kg CO <sub>2</sub> e) |
|-------------------------------|----------------------------------|
| 500                           | 177,010                          |
| 1,000                         | 379,120                          |
| 500                           | 211,125                          |
| 300                           | 131,634                          |
| <b>TOTAL</b>                  | <b>898,889</b>                   |

DON'T enforce limits  
at the individual mix  
design level

DO enforce limits  
at the project total level

# ADDRESSING SPECIALTY MIXES



CONCRETE  
CARBON

A GUIDELINE FOR SPECIFYING  
LOW CARBON READY MIXED CONCRETE  
IN CANADA



NOVEMBER 2025

Carbon intensity of concrete mixes can be impacted significantly when special Circumstances are considered, including:

- High-early strength
- Cold weather applications
- Specialty and high performance
  - Architectural
  - Low-shrinkage
  - Self-consolidating (SCC)
  - Shotcrete
  - Specialized durability (100+ yrs)

**Where specialized mixes are required, the baseline shall be 130% of the baseline mix.**

# ACCOUNTING FOR SPECIALTY MIXES

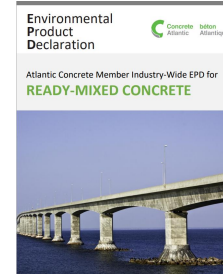


**CONCRETE  
CARBON**

A GUIDELINE FOR SPECIFYING  
LOW CARBON READY MIXED CONCRETE  
IN CANADA



NOVEMBER 2025



*Carbon Budgets for Concrete*

| Application | Strength (MPa) | Exposure Class | Max. GWP (kg CO <sub>2</sub> /m <sup>3</sup> ) |   |
|-------------|----------------|----------------|--|---|
| Footings    | 25             | N              | 354.02   | X |
| Slabs       | 30             | N              | 379.12 x 1.3                                   | X |
| Columns     | 35             | N              | 422.25   | X |
| Exterior    | 32             | C2             | 438.78   | X |

DON'T enforce limits  
at the individual mix  
design level

| Est. Volume (m <sup>3</sup> ) | Total GWP (kg CO <sub>2</sub> e) |
|-------------------------------|----------------------------------|
| 500                           | 177,010                          |
| 1,000                         | 492,856                          |
| 500                           | 211,125                          |
| 300                           | 131,634                          |
| <b>TOTAL</b>                  | <b>1,012,625</b>                 |

DO enforce limits  
at the project total level

# Atlantic Canada Case Study



# CONCRETE CARBON

A GUIDELINE FOR SPECIFYING  
LOW CARBON READY MIXED CONCRETE  
IN CANADA

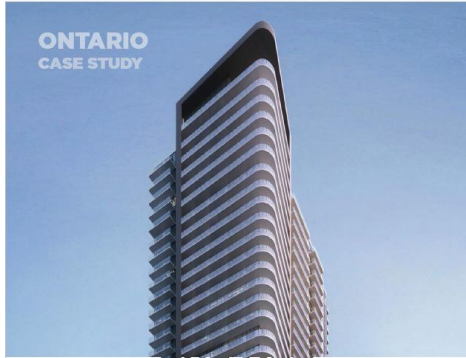


NOVEMBER 2025


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**ONTARIO**  
CASE STUDY



**THE MET**  
CONDOMINIUMS



DEVELOPER: PLAZA/BERKLEY DEVELOPMENTS

**ALBERTA** CASE STUDY



**DEVILLE**  
CONDOMINIUMS



DEVELOPER: REMINGTON DEVELOPMENT CORPORATION

**QUÉBEC** CASE STUDY




**ALBÉDO AND CPE MISTIGRI**




OWNER: GRT ACTION-HABITATION DE QUÉBEC

**BRITISH COLUMBIA**  
CASE STUDY



**HENRY HUDSON SCHOOL**



**ATLANTIC** CASE STUDY



**HOUSING**  
FOR HEALTHCARE





## **HOUSING FOR HEALTHCARE**



# **Project: 20-unit modular housing**

## **Client: Housing Trust of Nova Scotia**

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Architect: Supreme Homes

Contractor: HTNS Construction Team

Engineer: ABLE Engineering

Concrete Supplier: Bridgewater Ready Mix (BRM)

Mix Design Developer: W.S.Langley / Harbourside

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Project Carbon Reduction goal of 30%

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BRM available materials:

- GUL
- Fly Ash
- Local Coarse and Fine Agg
- Typical Admixtures (Air, WRA, HRWRA)



*Carbon Budgets for Concrete*

| Application | Strength (MPa) | Exposure Class | Max. GWP (kg CO <sub>2</sub> /m <sup>3</sup> ) |   |
|-------------|----------------|----------------|--|---|
| Footings    | 25             | F-2            | 354.02   | X |
| Footings    | 25             | N              | 379.12   | X |
| ICF Walls   | 25             | N              | 422.25   | X |
| Mud Slabs   | 11             | N              | No Baseline                                    | X |

| Est. Volume (m <sup>3</sup> ) | CO <sub>2</sub> Baseline (tonnes CO <sub>2</sub> ) |
|-------------------------------|--|
| 16                            | 5.9  |
| 51                            | 18.1   |
| 117                           | 41.4   |
| 107                           | 0  |
| <b>TOTAL</b>                  | <b>65.4</b>  |

DON'T enforce limits at the individual mix design level

DO enforce limits at the project total level



*Carbon Budgets for Concrete*

| Application | Strength (MPa) | Exposure Class | Type III Plant Specific EPD |
|-------------|----------------|----------------|-----------------------------|
| Footings    | 25             | F-2            | 255                         |
| Footings    | 25             | N              | 244                         |
| ICF Walls   | 25             | N              | 244                         |
| Mud Slabs   | 11             | N              | No Baseline                 |

X  
X  
X  
X

| Est. Volume (m <sup>3</sup> ) | CO <sub>2</sub> Project (tonnes CO <sub>2</sub> ) |
|-------------------------------|---|
| 16                            | 4.1   |
| 51                            | 12.4  |
| 117                           | 28.5  |
| 107                           | 0   |
| <b>TOTAL</b>                  | <b>45.1</b>                                       |



*CO<sub>2</sub> Baseline (tonnes CO<sub>2</sub>) = 65.4*

*CO<sub>2</sub> Project (tonnes CO<sub>2</sub>) = 45.1*

***CO<sub>2</sub> Reduction = 31.1%***

*CO<sub>2</sub> Reduction Goal= 30.0%*

# BARRIERS TO ADOPTING LOW CARBON CONCRETE

1. Education
2. Limited Availability of Materials
3. Regulatory / Prescriptive Specifications
4. Cost
5. Industry Resistance to Change

# Thank You!

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# HARBOURSIDE

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ENGINEERING GROUP

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