Working Session

ACCÉC Association Canadienne des Consultants en Économie de Construction
The Canadian Association of Consulting Quantity Surveyors CACQS

RICS

Canadian Standard on Embodied Carbon in Construction

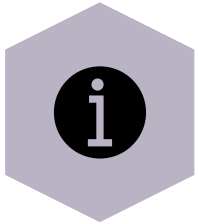
20 September 2023

Susan Neil (CACQS) and Anil Sawhney (RICS)

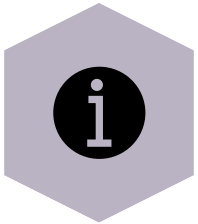
Topics covered

Decarbonization agenda for the built environment

Overview of the Canadian Standard



Worked example



Decarbonization agenda for the built environment

Decarbonizing the built environment—the need

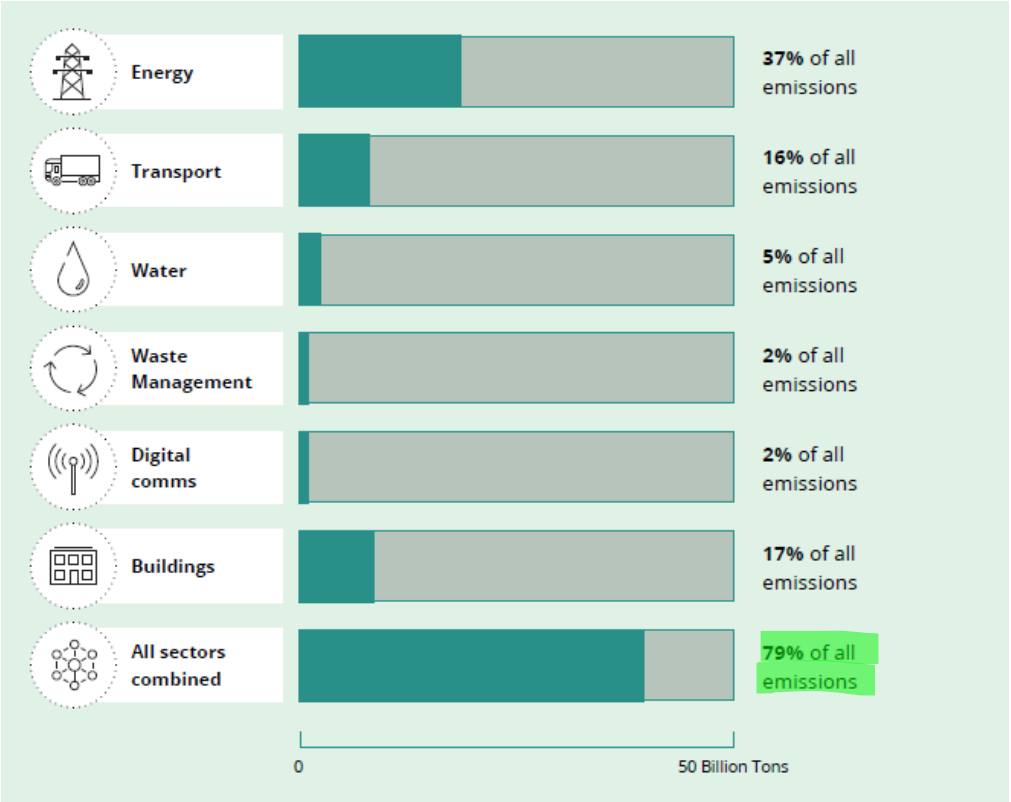
In 2021 built environment sector produced ~43% of the global carbon emissions (15.5 gigatonnes of carbon emissions).

	Whole life carbon (43%)		
	Operational Carbon		Embodied Carbon
	Direct	Indirect	
Residential	6%	11%	9%
Non-residential	3%	8%	
Infrastructure	-	-	6%
Total 43% (buildings = 37%)	28%		15%

Whole life carbon emissions = Operational Carbon + **Embodied Carbon** + (User carbon|Beyond life cycle carbon)

Source: United Nations Environment Programme (2022). 2022 Global Status Report for Buildings and Construction: Towards a Zero-emission, Efficient and Resilient Buildings and Construction Sector. Nairobi.

Emissions when considering user carbon



Including emissions associated with the user's utilisation of the buildings or infrastructure during the use stage

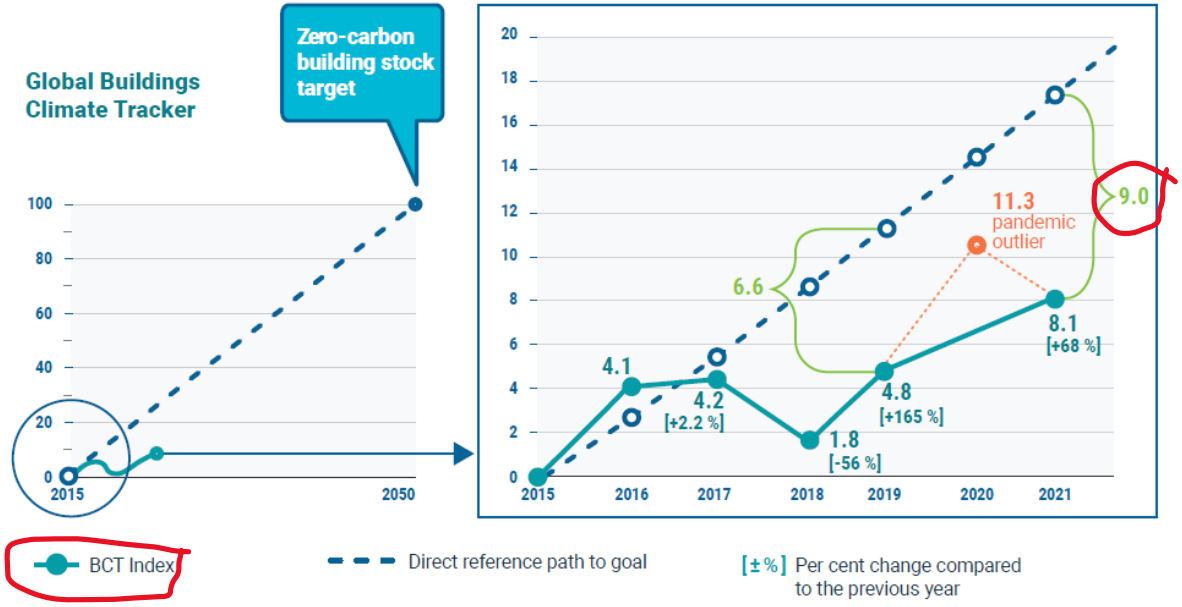
Source: Thacker S, Adshead D, Fantini C, Palmer R, Ghosal R, Adeoti T, Morgan G, Stratton-Short S. 2021. Infrastructure for climate action. UNOPS, Copenhagen, Denmark.

Progress {not}made!

The warning Pace and scale of climate action are insufficient to tackle climate change

ipcc

Figure 2. Direct reference path to a zero-carbon building stock target in 2050 (left); zoom into the period between 2015 and 2021, comparing the observed Global Buildings Climate Tracker to the reference path (right)



Source: Adapted by the Buildings Performance Institute Europe.

Source: United Nations Environment Programme (2022). 2022 Global Status Report for Buildings and Construction: Towards a Zero-emission, Efficient and Resilient Buildings and Construction Sector. Nairobi.

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2030 ERP: BUILDINGS

Transitioning Canada's building stock to net-zero over the long term creates new opportunities to promote a low-carbon supply chain, adopt net-zero ready building codes, transform space and water heating, improve affordability through energy efficiency, and accelerate private financing and workforce development to support the sector's transition.

2005 emissions: **84 Mt** | 2019 emissions: **91 Mt** | Estimated change from 2005 to 2030: **-37%**

- Net zero by 2050
- Invest $150 million to develop a national net zero by 2050 buildings strategy, the Canada Green Buildings Strategy

Environment and Climate Change Canada | Environnement et Changement climatique Canada

Canada

Source: https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/climate-plan-overview/emissions-reduction-2030/plan/chapter-3.html

RICS

CITY OF VANCOUVER

Home > Green Vancouver > Climate Emergency Action Plan > Buildings

Green Vancouver

- Climate Emergency Action Plan
  - Land use planning
  - Transportation
  - **Buildings**
  - Natural climate solutions
  - An equitable plan
  - In depth
  - Zero emissions buildings
  - Neighbourhood Energy Strategy
- Climate Change Adaptation Strategy
- Green Operations Plan
- Zero Waste 2040
- Opportunities for climate leaders
- Greenest City Action Plan
- Solutions Lab

By 2030, indoor air quality will be improved in renovated buildings.

Climate action through buildings

Burning natural gas, a fossil fuel, in buildings (for space and water heating) accounts for 55% of the carbon pollution generated in Vancouver. Construction creates additional emissions locally and globally through the production and transportation of building materials.

2030 targets

- Carbon pollution from buildings will be half what it was in 2007
- There will be 40% less embodied emissions from new buildings and construction projects compared to 2018

Source: https://vancouver.ca/green-vancouver/buildings.aspx#:~:text=Burning%20natural%20gas%2C%20a%20fossil,and%20transportation%20of%20building%20materials.

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Buildings Energy, Emissions & Resilience

Performance measures to optimize energy efficiency, reduce GHG emissions and enhance building resilience to extreme weather.

Expand All + Collapse All −

Operational Emissions and Energy +

Embodied Emissions In Materials −

TIER 2

GHG 2.1 Low Embodied Emissions Materials

Conduct an Upfront Embodied Emissions Assessment for the structure and envelope in accordance with the CaGBC Zero Carbon Building Standard methodology for the Upfront Carbon lifecycle stage (A1-A5). Identify low-carbon sustainable material alternatives to the proposed structure and/or envelope for use in the building project. The report must demonstrate an emissions intensity of equal to or less than 350 $kgCO2e/m^2$. [1,2,3,5,6]

Source: https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/toronto-green-standard/toronto-green-standard-version-4/mid-to-high-rise-residential-non-residential-version-4/buildings-energy-emissions-resilience/#:~:text=Residential%20and%20commercial%20projects%20must,400%20kgCO2%2Fm2%2Fyr.

Findings from RICS sustainability report 2022

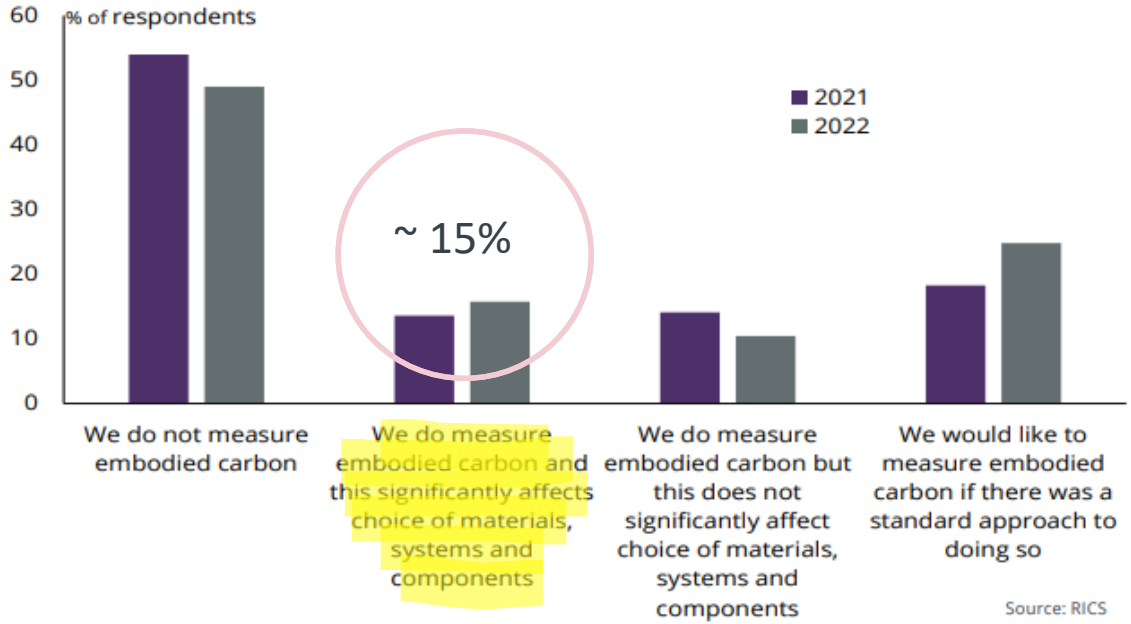


Figure 12 Currently, do you measure embodied carbon emissions on your projects and, if so, how significantly does this affect the choice of materials, systems and components?

Source: https://www.rics.org/content/dam/ricsglobal/documents/surveying/2022%20RICS%20Sustainability%20Report.pdf

Findings from RICS sustainability report 2022

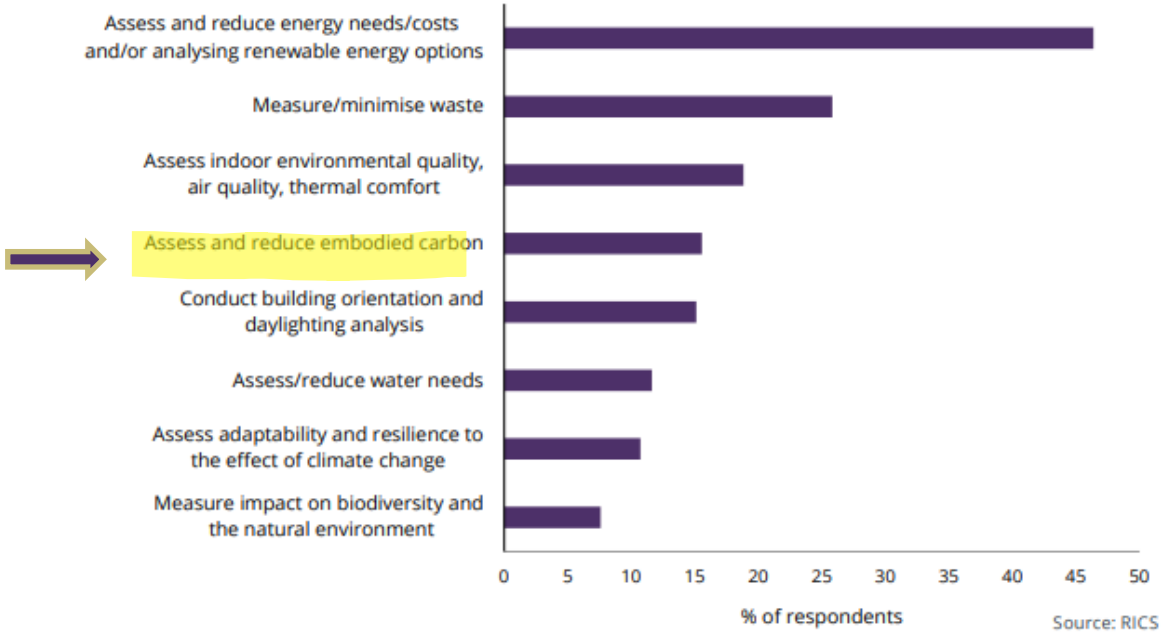


Figure 10 Principle uses of digital tools and processes when completing environmental and sustainability assessments

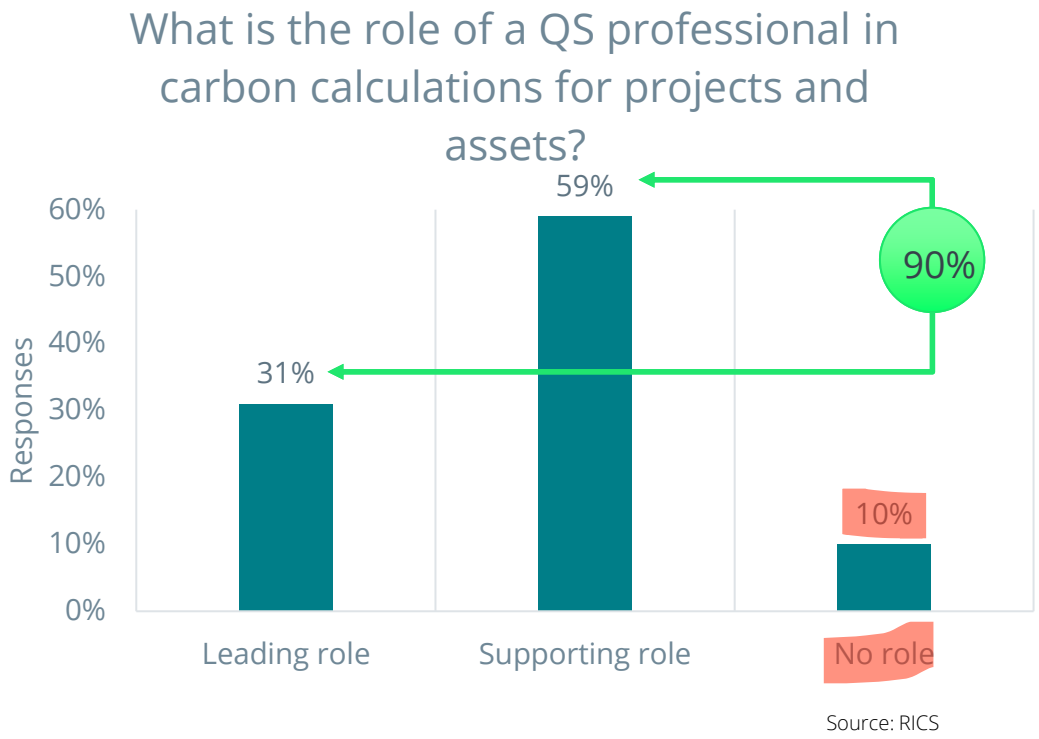
Source: https://www.rics.org/content/dam/ricsglobal/documents/surveying/2022%20RICS%20Sustainability%20Report.pdf

Findings from RICS sustainability report 2022

Figure 13 Principal barriers inhibiting the construction sector from reducing embodied carbon emissions

Source: https://www.rics.org/content/dam/ricsglobal/documents/surveying/2022%20RICS%20Sustainability%20Report.pdf

Findings from RICS Digitalization in Construction 2022 report



Source: RICS

Source: https://www.rics.org/news-insights/wbef/power-of-data-and-technology-for-quantity-surveyors-and-cost-managers

GHG and GWP

CO_2e, Carbon dioxide equivalent,
CO_2 equivalent or CO_2eq

Kyoto Gases
(IPCC 2007)

	Greenhouse Gas	Global Warming Potential (GWP)
1	Carbon dioxide (CO_2)	1
2	Methane (CH_4)	25
3	Nitrous oxide (N_2O)	298
4	Hydrofluorcarbons (HFCs)	124 – 14,800
5	Perfluorocarbons (PFCs)	7,390 – 12,200
6	Sulfur hexafluoride (SF_6)	22,800
7	Nitrogen trifluoride (NF_3)	17,200

GWP indicates the amount of warming a gas causes over 100 years (GWP100).

Carbon, Carbon emissions, emissions, Co_2e emissions, etc.

Source: https://www.coolerfuture.com/blog/co2e

What is Co_2e?

Carbon dioxide equivalents are commonly expressed as million metric tonnes of carbon dioxide equivalents (MMTCDE).

Co_2e ~ 250.01 grams per kilometer

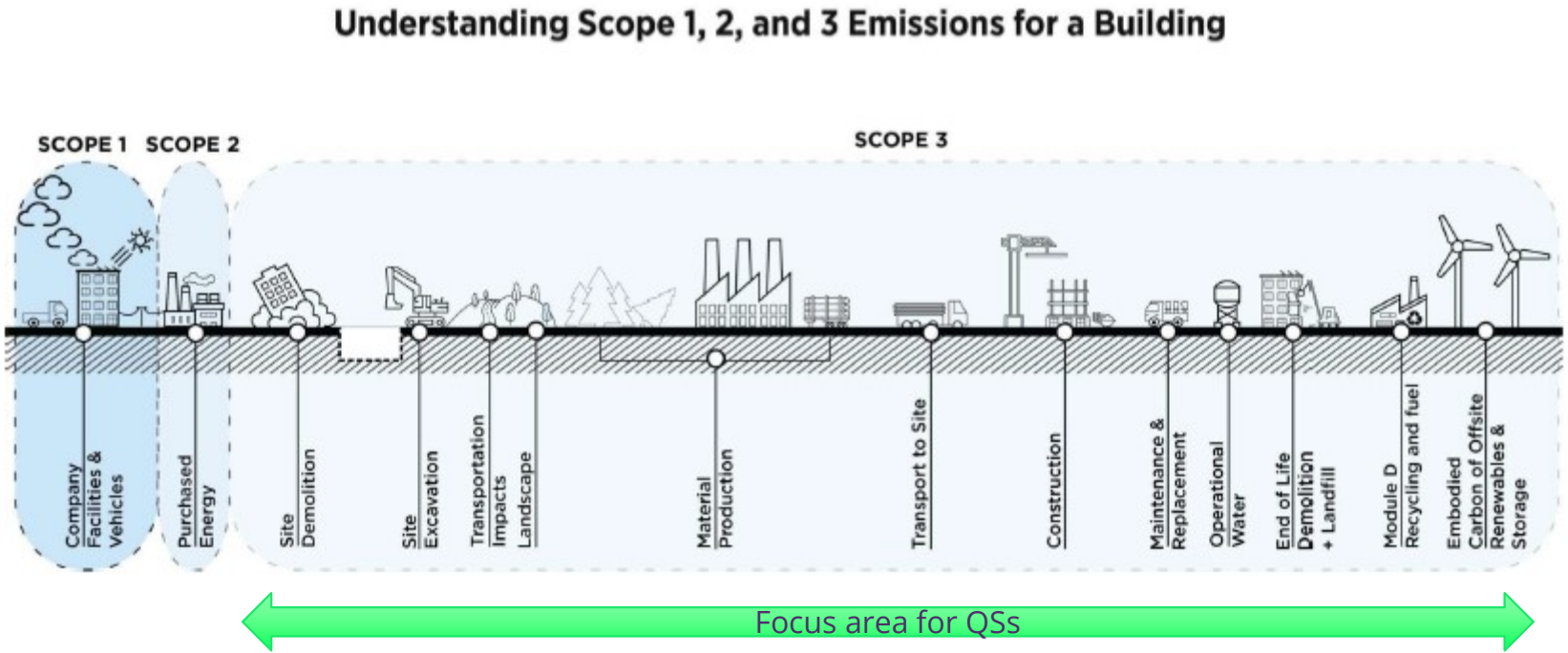
- 250 grams per kilometer — Carbon dioxide (CO_2)
- 0.01 grams per kilometer — Methane (CH_4)
- 0.00225 grams per kilometer — Nitrous oxide (N_2O)
- Negligible Fluorinated gases
  - Hydrofluorcarbons (HFCs)
  - Perfluorocarbons (PFCs)
  - Sulfur hexafluoride (SF_6)
  - Nitrogen trifluoride (NF_3)

Conventional Gasoline Cars

A typical passenger vehicle emits about 4.6 metric tons of CO_2e per year.

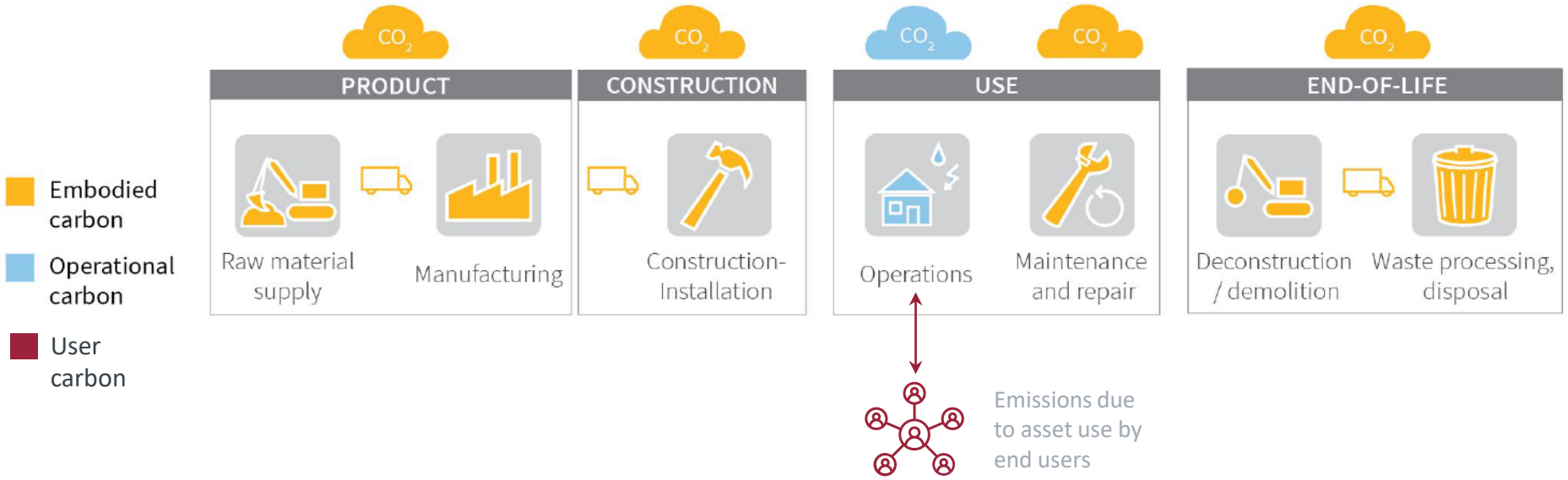
Source: https://www.epa.gov/greenvehicles/tailpipe-greenhouse-gas-emissions-typical-passenger-vehicle#typical-passenger and https://labs.ece.uw.edu/community/EnvironmentalImpacts/ElectricVehicleCalculations/

Who measures what?



Source: https://lmnarchitects.com/lmn-research/02-whos-responsible-for-carbon-emissions-anyway

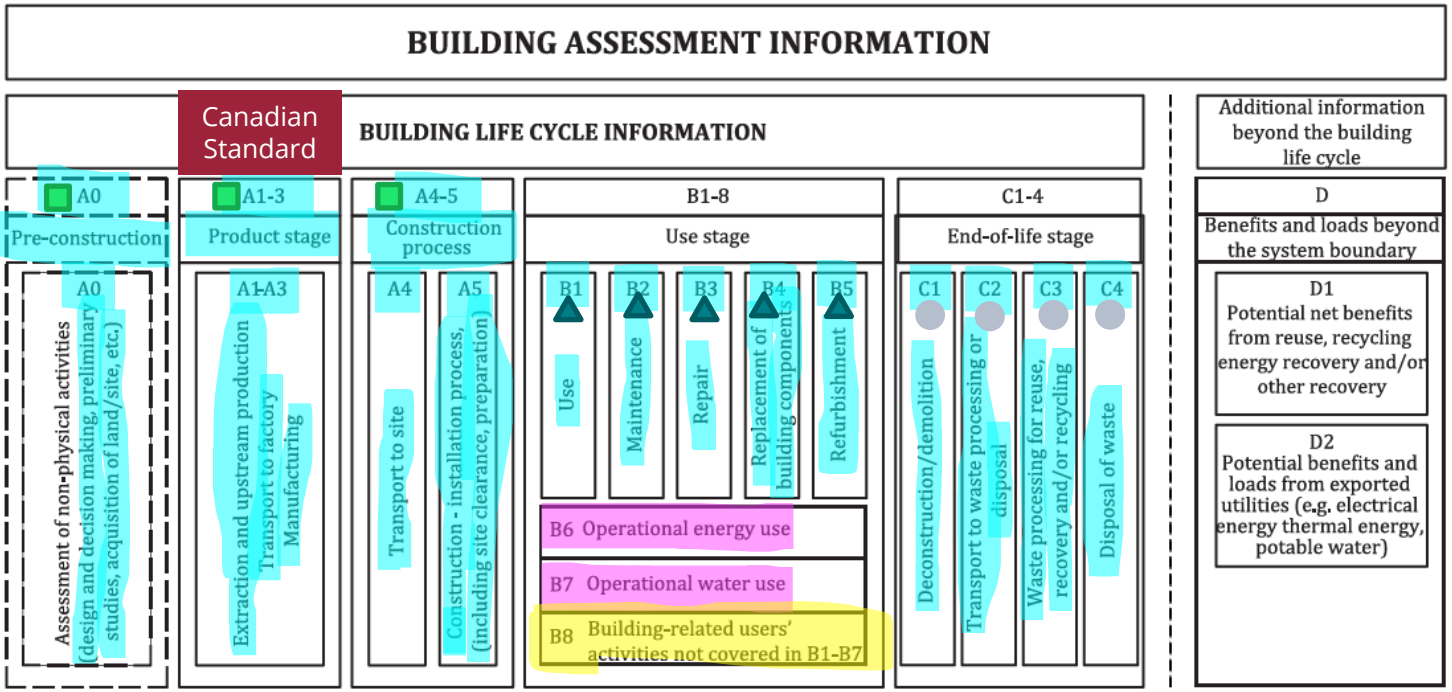
Types of emissions



Source: https://carbonleadershipforum.org/embodied-carbon-101/

What are life cycle emissions?

BS ISO 21931-1:2022
ISO 21931-1:2022



Embodied Carbon

Operational Carbon

User Carbon

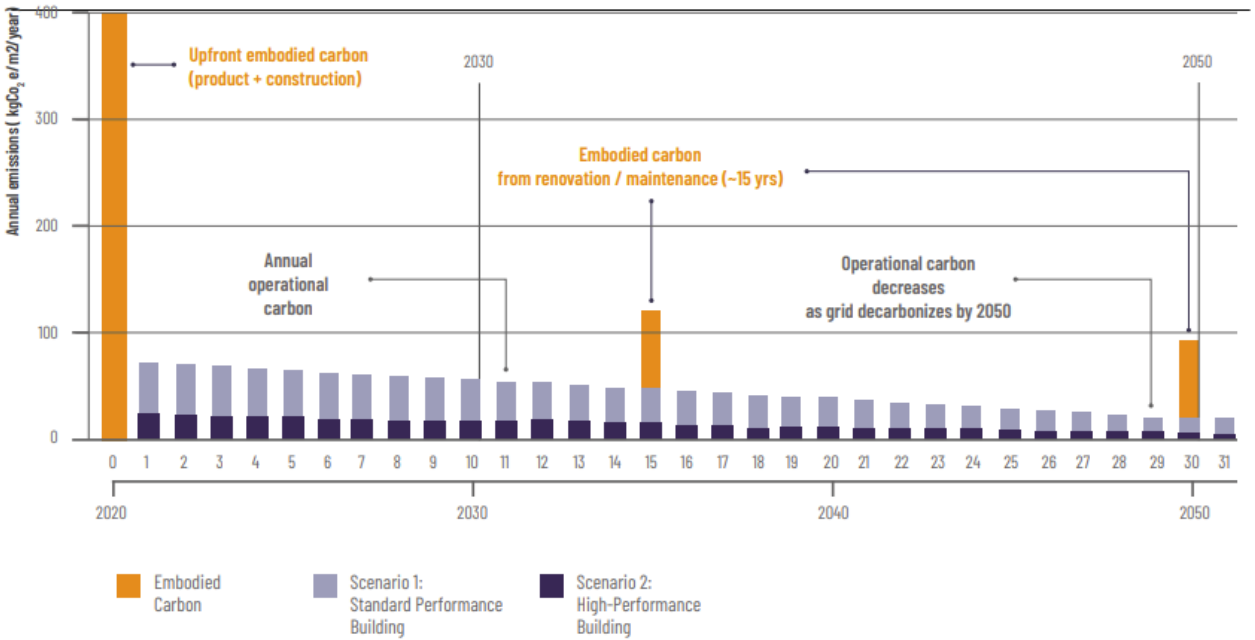
Upfront Embodied Carbon

Use-stage Embodied Carbon

End-of-life Embodied Carbon

For Infrastructure (PAS 2080): Capital Carbon, Operational Carbon, and User Carbon

Emissions over the life of a constructed asset

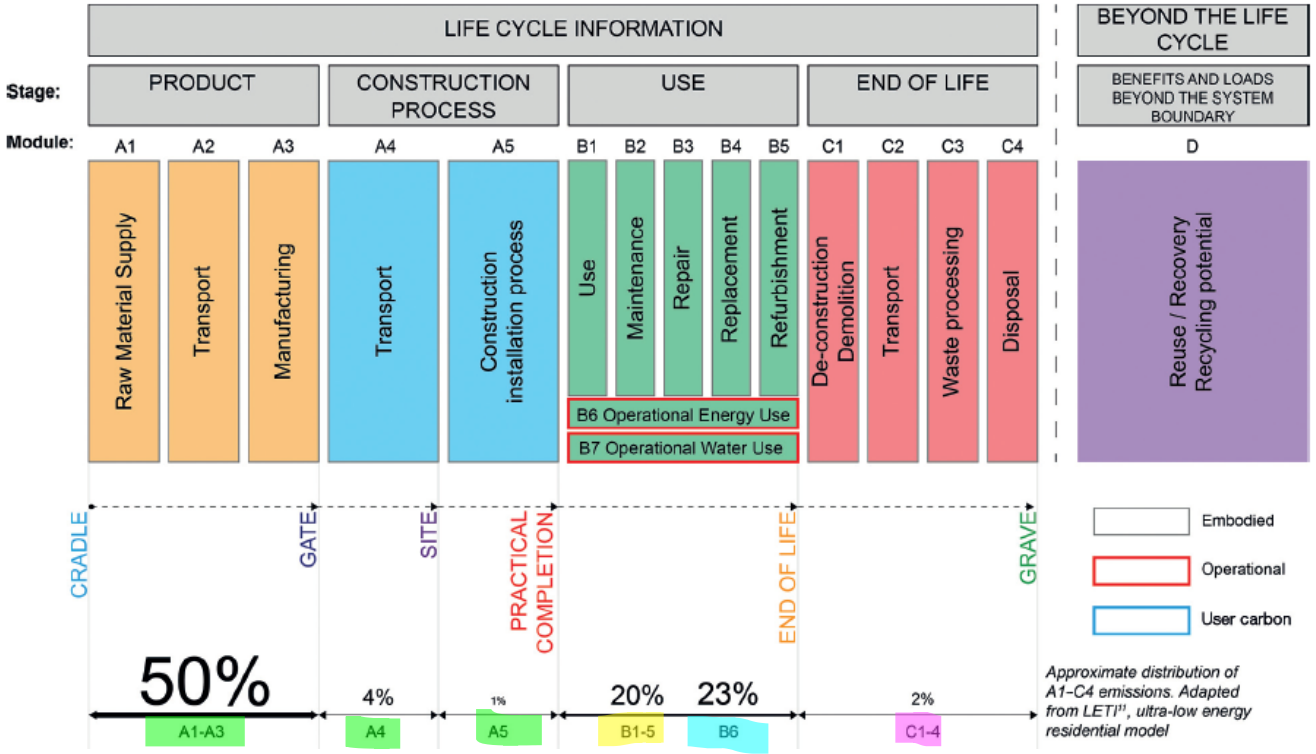


Operational carbon will continue to decrease with grid decarbonisation, while embodied carbon is set to remain high without meaningful action.

Adapted from Carbon Leadership Forum 2020.

Source: https://carbonleadershipforum.org/clf-architect-toolkit/

Focus on embodied carbon



Source: https://www.istructe.org/resources/guidance/how-to-calculate-embodied-carbon/

The process

	Concept Stage (1)	Design Stage (2)	Procurement Stage (3)	Construction Stage (4)	Practical Completion Stage (5)
	Data at asset level	Data at asset and sub-asset level	Data from estimates	Data from work performance	Data from as-built
$	Asset level benchmarks	Asset and sub-asset level benchmarks	Estimated quantities by element	Actual quantities including waste	As-built quantities
Data needed	$ / sf Kg Co_2e / sf	$ / sf Kg Co_2e / sf	Industry-wide EPDs	Product/Plant EPDs	Product/Plant EPDs

Carbon intensity factors

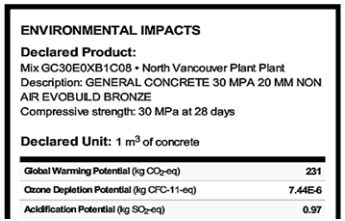
BECD
Built Environment Carbon Database

Life cycle analysis

Environmental Product Declaration

CONCRETEBC

Concrete BC Member Industry-Wide EPD for
READY-MIXED CONCRETE



ENVIRONMENTAL IMPACTS

Declared Product:
Mix GC30E0XB1C08 • North Vancouver Plant Plant
Description: GENERAL CONCRETE 30 MPA 20 MM NON AIR EVOBUILD BRONZE
Compressive strength: 30 MPa at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	231
Ozone Depletion Potential (kg CFC-11-eq)	7.44E-6
Acidification Potential (kg SO_2-eq)	0.97

RICS

What is an Environmental product declaration (EPD)?

- EPDs provide verified environmental (performance or impact) data of products based on LCA
- Designers, engineers, cost managers, and other experts use this data to compute carbon footprint of constructed assets
- Third-party verification is required
- Based on ISO 14025 + ISO 21930

NATIONAL READY MIXED CONCRETE COMPANY

ENVIRONMENTAL IMPACTS

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Acidification Potential (kg SO_2-eq)	0.97
Eutrophication Potential (kg N-eq)	0.24
Photochemical Ozone Creation Potential (kg O_3-eq)	26.1
Abiotic Depletion, non-fossil (kg Sb-eq)	7.06E-6
Abiotic Depletion, fossil (MJ)	1,290
Total Waste Disposed (kg)	0.58
Consumption of Freshwater (m^3)	4.35

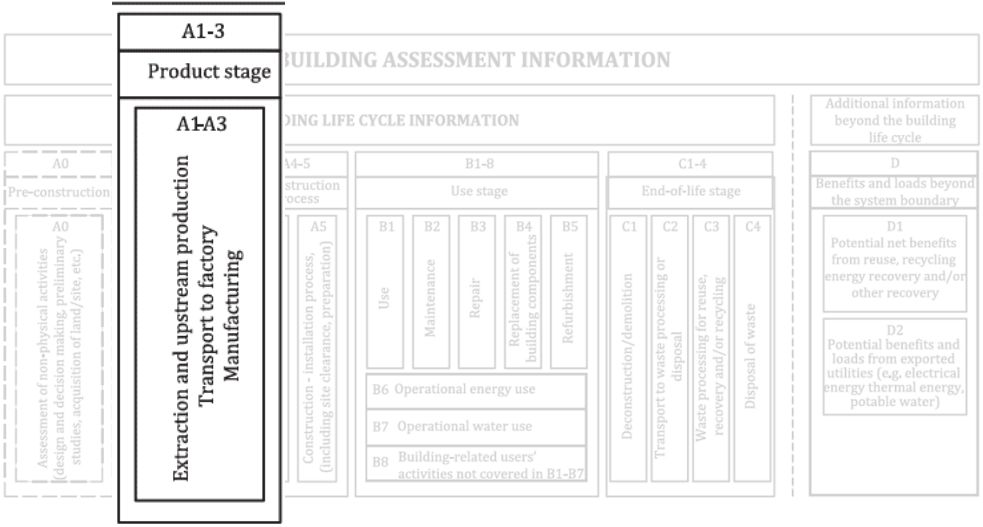
Product Components: admixture (ASTM C494), crushed aggregate (ASTM C33), natural aggregate (ASTM C33), portland limestone cement (ASTM 595), batch water (ASTM C1602)

Complex world of EPDs

- ISO has three types of environmental claims (all are based on ISO 14020:2000 Environmental labels and declarations — General principles):
  - Type I environmental claims (ISO 14024:2018— Type I environmental labelling)
  - Type II environmental claims (ISO 14021:2016 — Self-declared environmental claims)
  - Type III environmental claims (ISO 14025:2006 — Type III environmental declarations + use LCA described in ISO 14040:2006 and ISO 14044:2006)
    - Several EN standards are also available for EPDs such as EN 15942 and EN 15804
    - Specifically for construction ISO 21930

What do EPDs cover?

Canadian Standard

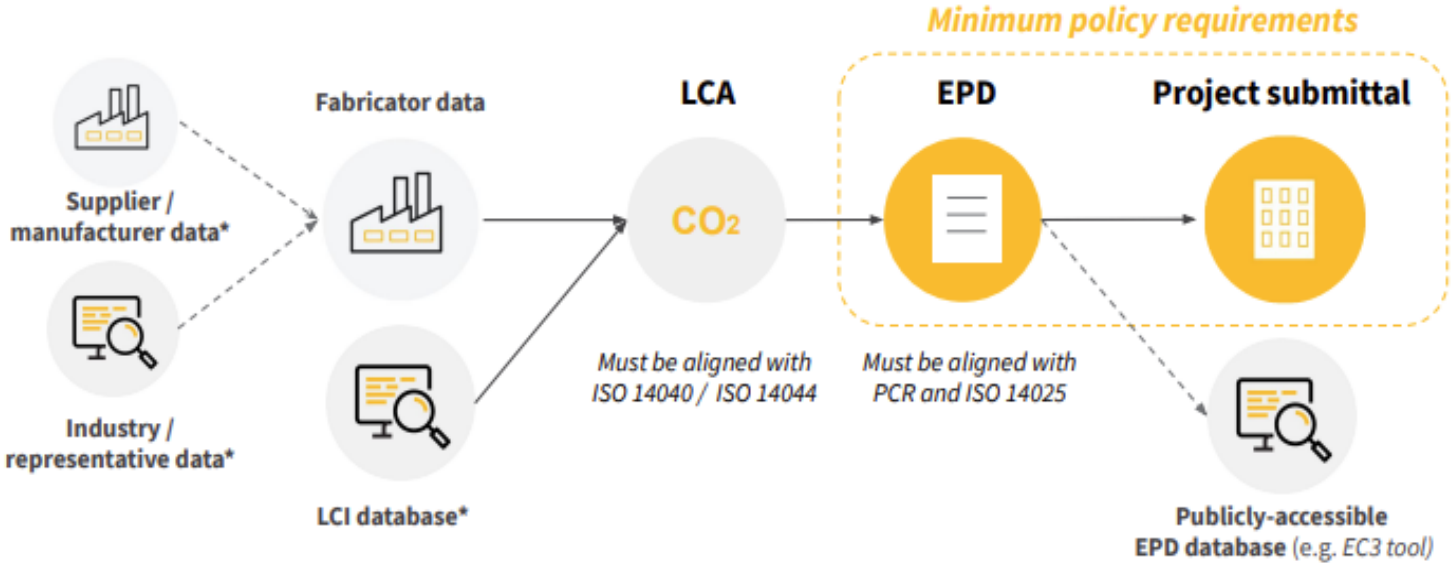


TRACI 2.1 used in North America (CML used elsewhere)

Table 5. Life Cycle Category Indicators and Inventory Metrics			
#	LCIA Indicators	Abbreviations	Units
1	Global Warming Potential (climate change)	GWP	kg CO2-eq
2	Ozone Depletion Potential	ODP	kg CFC-11-eq
3	Acidification Potential	AP	kg SO2-eq
4	Eutrophication Potential	EP	kg N-eq
5	Photochemical Ozone Creation/Smog Potential	POCP	kg O3-eq
	Inventory Metrics		
6	Total primary energy consumption	PEC	MJ (HHV)
7	Depletion of non-renewable energy resources	NRE	MJ (HHV)
8	Use of renewable primary energy	RE	MJ (HHV)
9	Depletion of non-renewable material resources	NRM	kg
10	Use of renewable material resources	RM	kg
11	Concrete batching water consumption	CBW	m3
12	Concrete washing water consumption	CWW	m3
13	Total water consumption	TW	m3
14	Concrete hazardous waste	CHW	kg
15	Concrete non-hazardous waste	CNHW	kg

Uses—Product Category Rule (PCR) for Environmental Product Declarations, PCR for Concrete

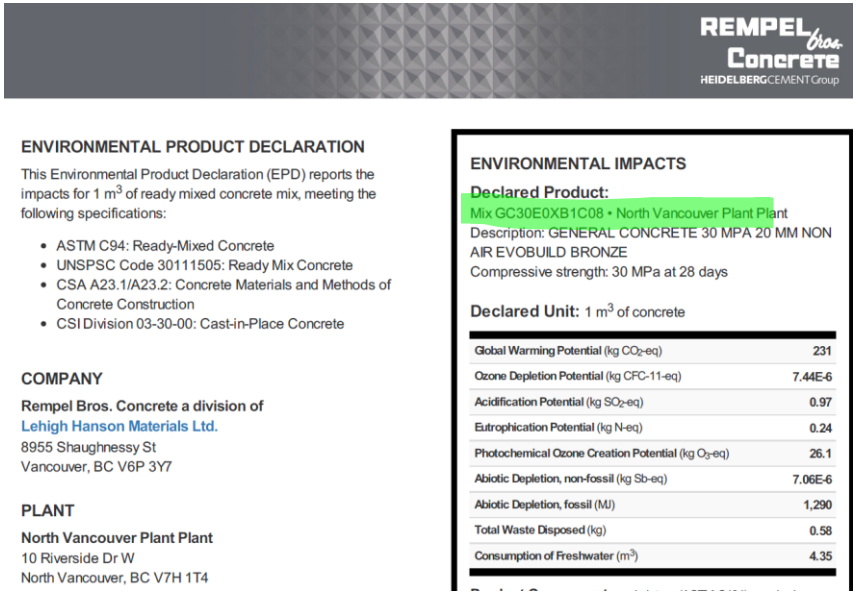
How are EPDs developed?



https://carbonleadershipforum.org/download/35311/?tmstv=1692300520&dlm-dp-dl-force=1&dlm-dp-dl-nonce=620fe561f9

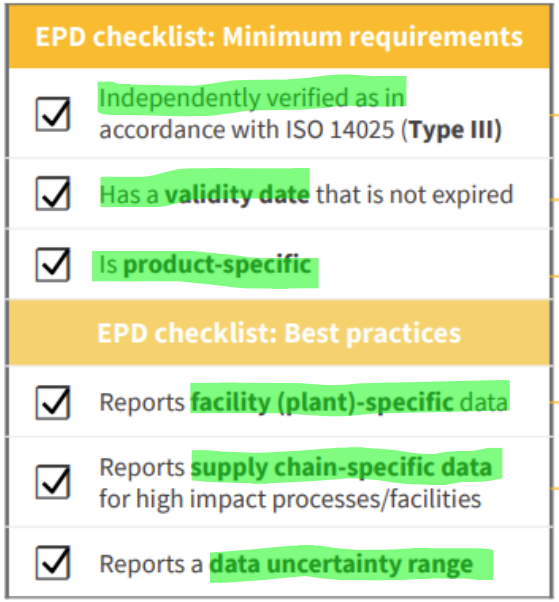
Industry-wide (regional) EPD versus Product (Plant) specific EPD

Appendix A - baseline



Appendix B – project mixes

Further guidance on EPDs by Carbon Leadership Forum



A **Type III EPD** is one that has been independently verified to be in accordance with *ISO 14025 - Type III environmental declarations – Principles and procedures.*

EPDs are **valid** for five years from the date of issue. All EPDs state the date of issue and period of validity.

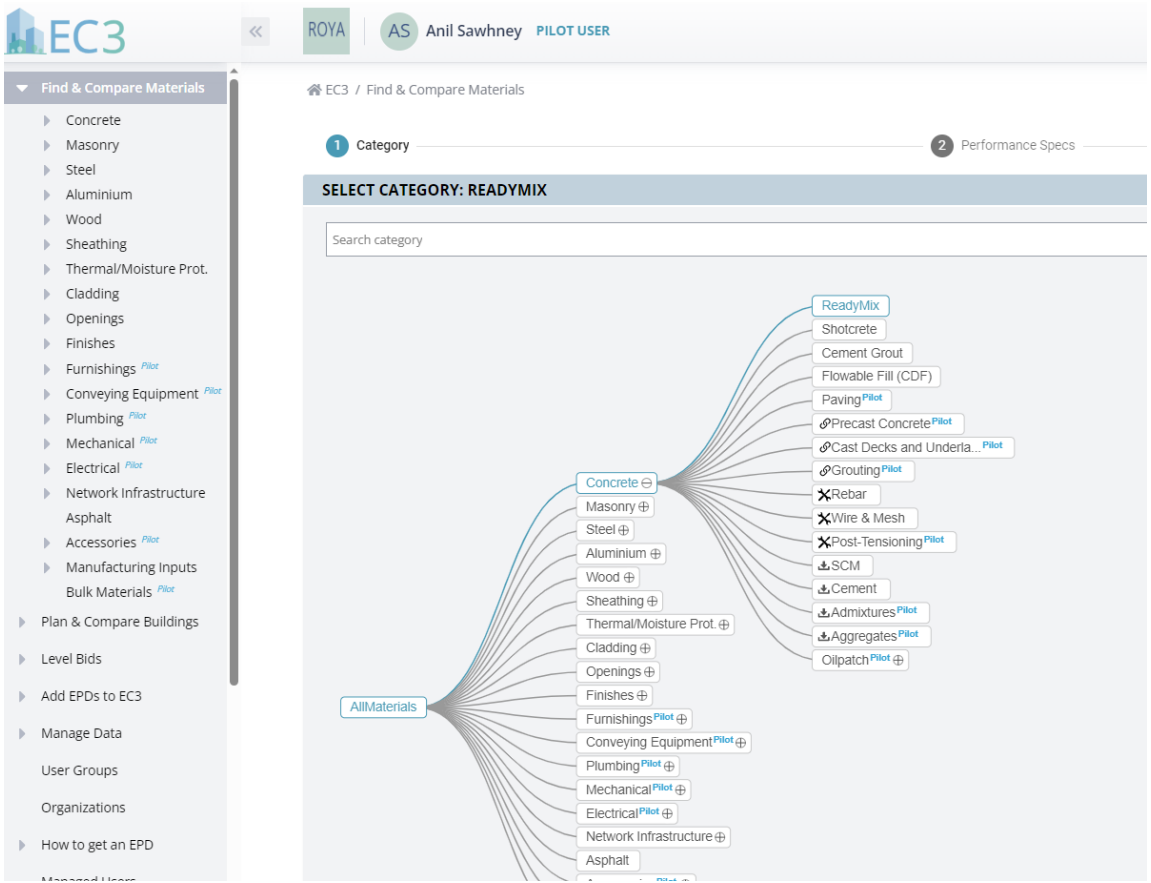
A **product-specific** EPD represents a product from a single manufacturer. An industry-wide average EPD is not a product-specific EPD.

An EPD with **facility (plant)-specific data** reports impacts calculated based on inputs collected from the actual facility (or facilities) where the product was manufactured.

Supply chain-specific data is based on inputs from the actual supply chain of a product, rather than generic or industry-wide data. EPDs should report the overall percent (%) supply chain-specific data. Ideally, EPDs should target to include supply chain-specific data for processes or facilities that comprise 80% or more of the cradle-to-gate impacts of a product.

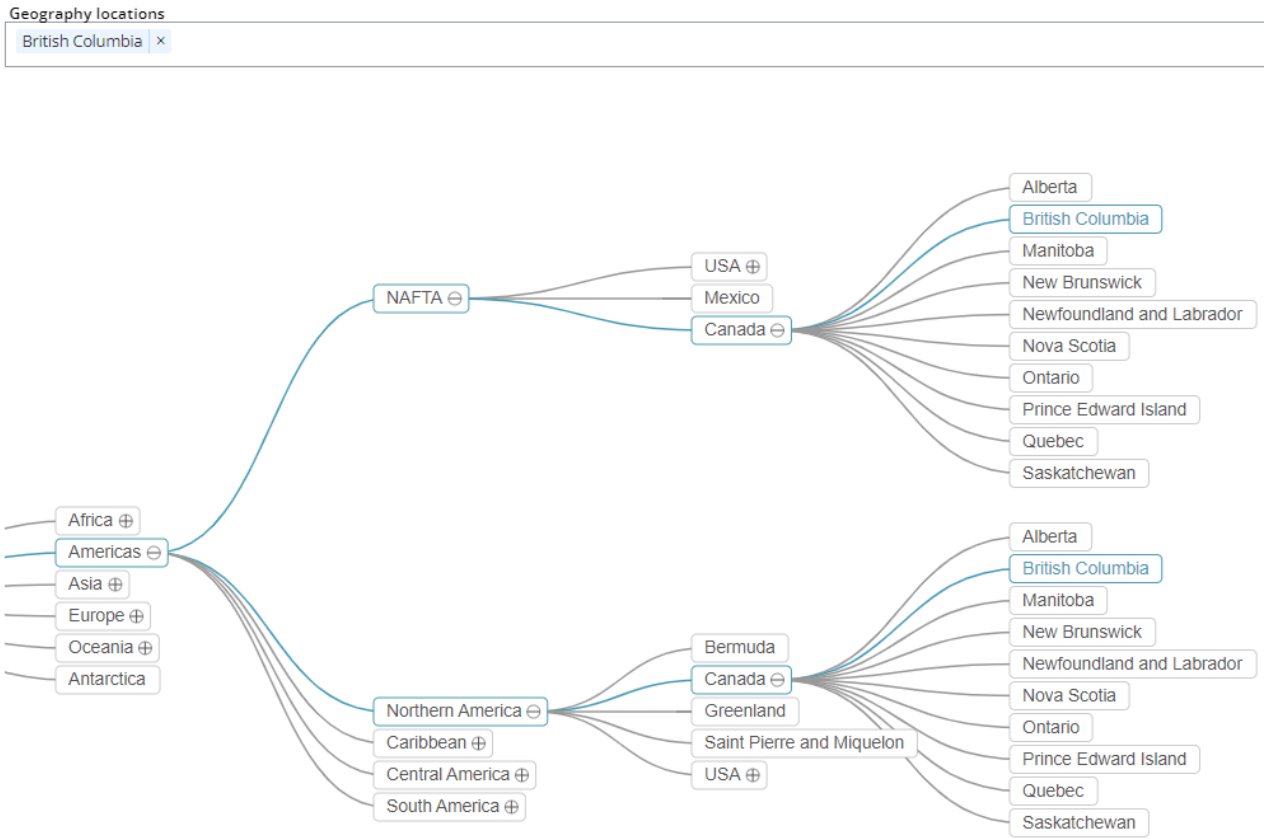
https://carbonleadershipforum.org/download/35311/?tmstv=1692300520&dlm-dp-dl-force=1&dlm-dp-dl-nonce=620fe561f9

Use EC3 to search for EPDs (step 1)



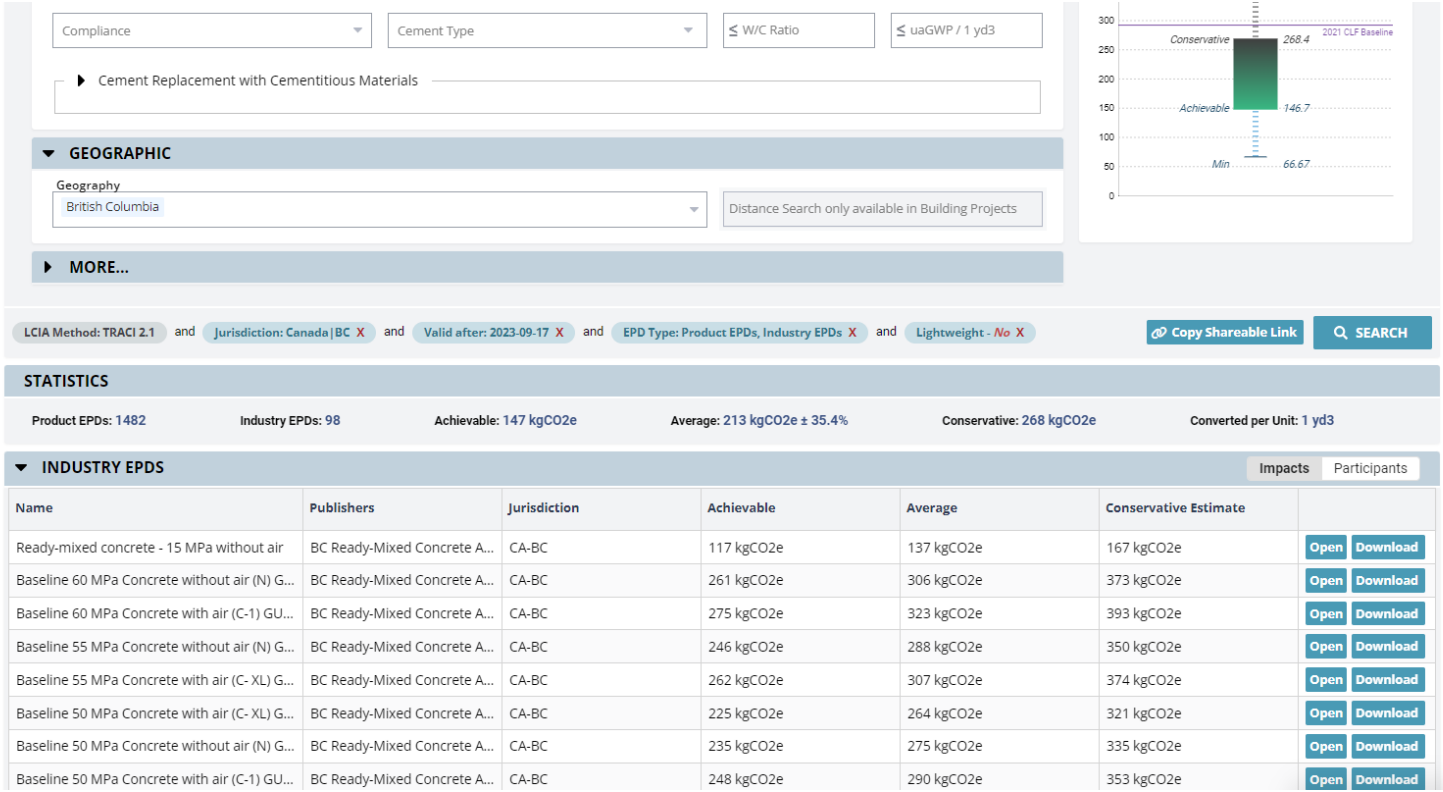
Source: EC3 - Find & Compare Materials (buildingtransparency.org)

Use EC3 to search for EPDs (step 2)



Source: EC3 - Find & Compare Materials (buildingtransparency.org)

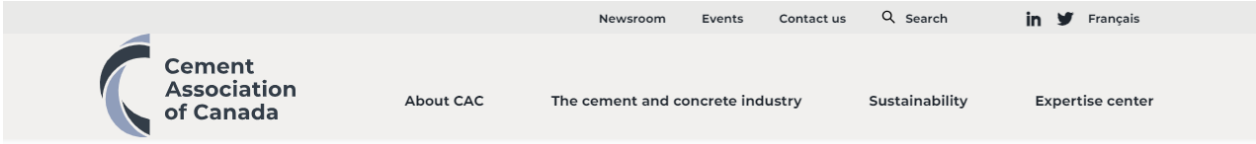
Use EC3 to search for EPDs (step 3)



Name	Publishers	Jurisdiction	Achievable	Average	Conservative Estimate	
Ready-mixed concrete - 15 MPa without air	BC Ready-Mixed Concrete A...	CA-BC	117 kgCO2e	137 kgCO2e	167 kgCO2e	Open Download
Baseline 60 MPa Concrete without air (N) G...	BC Ready-Mixed Concrete A...	CA-BC	261 kgCO2e	306 kgCO2e	373 kgCO2e	Open Download
Baseline 60 MPa Concrete with air (C-1) GU...	BC Ready-Mixed Concrete A...	CA-BC	275 kgCO2e	323 kgCO2e	393 kgCO2e	Open Download
Baseline 55 MPa Concrete without air (N) G...	BC Ready-Mixed Concrete A...	CA-BC	246 kgCO2e	288 kgCO2e	350 kgCO2e	Open Download
Baseline 55 MPa Concrete with air (C- XL) G...	BC Ready-Mixed Concrete A...	CA-BC	262 kgCO2e	307 kgCO2e	374 kgCO2e	Open Download
Baseline 50 MPa Concrete with air (C- XL) G...	BC Ready-Mixed Concrete A...	CA-BC	225 kgCO2e	264 kgCO2e	321 kgCO2e	Open Download
Baseline 50 MPa Concrete without air (N) G...	BC Ready-Mixed Concrete A...	CA-BC	235 kgCO2e	275 kgCO2e	335 kgCO2e	Open Download
Baseline 50 MPa Concrete with air (C-1) GU...	BC Ready-Mixed Concrete A...	CA-BC	248 kgCO2e	290 kgCO2e	353 kgCO2e	Open Download

Source: EC3 - Find & Compare Materials (buildingtransparency.org)

Sources of industry EPDs



EPD General Use and Portland- Limestone Cements

ASTM — Environment Product Declarations

CRMCA Member Industry-Wide EPD for Canadian Ready-Mixed Concrete

Provincial and specific product EPDs

Concrete BC — Ready-Mixed Concrete

Concrete Alberta — Ready-Mixed Concrete

Concrete Saskatchewan — Ready-Mixed Concrete

Concrete Manitoba — Ready-Mixed Concrete

Concrete Ontario — Ready-Mixed Concrete

Association béton Québec — Ready-Mixed Concrete

Concrete Atlantic — Ready-Mixed Concrete

CPCI — Structural Precast Concrete

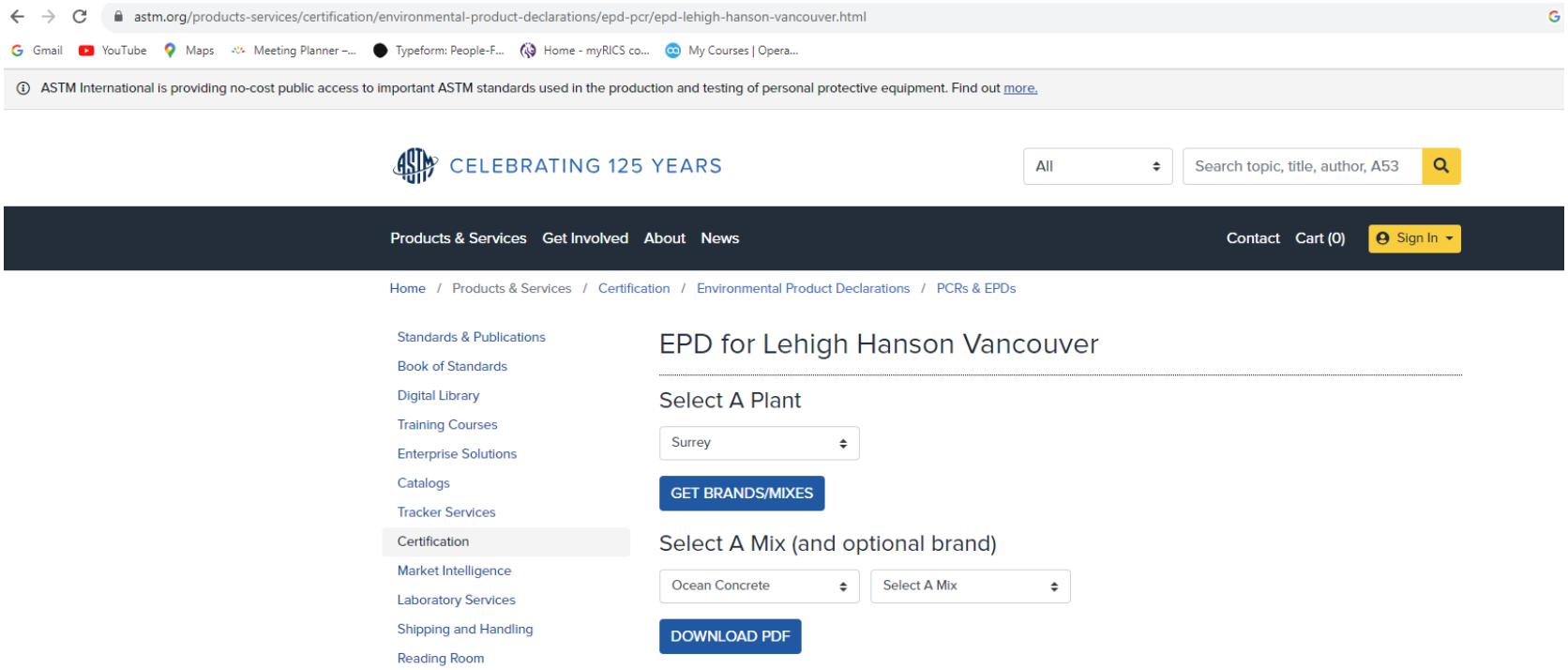
CPCI — Insulated Precast Panel Concrete

CPCI — Below Grade Precast Concrete

CCPPA — Concrete Manholes and Catch Basins

CCPPA — Concrete Pipe

Sources of product EPDs



Source: https://www.astm.org/products-services/certification/environmental-product-declarations/epd-pcr/epd-lehigh-hanson-vancouver.html

Overview of the Canadian Standard

Government of Canada | Gouvernement du Canada

Standard on Embodied Carbon in Construction

- Issued pursuant to the *Policy on Green Procurement* and is consistent with the *Policy on the Planning and Management of Investments* and the *Directive on the Management of Procurement*

- Sets minimum requirements for the procurement of design and construction services to disclose and reduce the embodied carbon of major construction projects
- Applies to renovation or new construction of buildings or engineering assets
- Standard took effect on December 31, 2022

Source: https://www.tbs-sct.canada.ca/pol/doc-eng.aspx?id=32742

RICS

Organizations covered and requirements to be met

- Applies to organizations described in section 3 of the *Policy on Green Procurement (Financial Administration Act Schedule I)*

- Organizations must meet:
  - Requirements for design services
  - Requirements for construction services
  - Provide a consolidated report that details the embodied carbon footprint for all construction projects completed in the previous fiscal year

Source: https://www.tbs-sct.canada.ca/pol/doc-eng.aspx?id=32742

Requirements in the procurement of DESIGN services

Disclose the carbon footprint of structural materials in accordance with Appendix A

Reduce the carbon footprint of structural materials in accordance with Appendix A

Ensure that structural materials are specified by a registered professional engineer

Review the completed Appendix B before project completion to ensure compliance

Source: https://www.tbs-sct.canada.ca/pol/doc-eng.aspx?id=32742

Requirements in the procurement of CONSTRUCTION services

Ensure Appendix B is secured before project completion, and complies with Appendix A

Disclose the embodied carbon footprint of structural materials measured in GWP with EPDs

EPDs should: (a) reference material supplier's name or professional association; (b) comply with international standards; and (c) produced using highest available resolution LCI data

Where EPDs are not readily available, provide LCA report as per ISO 14044, ISO 14025, and ISO 21930 or equivalent and is verified by an LCA reviewer

Source: https://www.tbs-sct.canada.ca/pol/doc-eng.aspx?id=32742

Appendix A-requirement for the disclosure of and reduction

- Applies to ready mix concrete
- For projects or programs at or above $10 million where design services are solicited on or after December 31, 2022, and $5 million where design services are solicited after December 31, 2024.
- Minimum material quantity - 100 m^3 (sum of all mixes used) *{based on Class A estimate}*
- Minimum resolution for disclosure is the highest-resolution EPD available (for example, product-specific, regional average, in that order)
- GHG emissions of procured ready-mix concrete shall be disclosed on a project basis and be substantiated with EPDs

Source: https://www.tbs-sct.canada.ca/pol/doc-eng.aspx?id=32742

Exemptions

- This standard does not apply:
  - If the project is in a geographic area (Yukon, Nunavut or the Northwest Territories) excluded from a requirement, as identified in Appendix A.

Source: https://www.tbs-sct.canada.ca/pol/doc-eng.aspx?id=32742

Disclosure - CO_2e baseline and project

- **Baseline** represents the emissions calculated by the volumes of all the mixes used in the project multiplied by their regional average GWP as represented by:

$$CO^2e\ Baseline = \sum_{1}^{n} Vol_n \times BaseGWP_n$$

- **Project** represents the emissions from the concrete used in the project calculated by the volumes of all the mixes used in the project multiplied by their GWP as represented by:

$$CO^2eProject = \sum_{1}^{n} Vol_n \times GWP_n$$

- Where:
  - n = the total number of concrete mixes used in the project
  - Vol_n = the volume of mix n
  - GWP_n = the global warming potential of mix n
  - $BaseGWP_n$ = the global warming potential of the regional baseline mix taken from the Regional Industry Average EPD for the strength class of mix n

Source: https://www.tbs-sct.canada.ca/pol/doc-eng.aspx?id=32742

Reduction

$$GHG\ Reduction\ =\ CO_2e\ Baseline\ -CO_2e\ Project$$

$$\%\ GHG\ Reduction\ =\ \frac{(GHG\ Reduction)\times 100}{CO_2e\ Baseline}$$

Special application requirements:

- Where a specialized concrete mix is required for high early strength, high or ultra-high performance, or cold-weather application, the benchmark BaseGWP used for that mix shall be 130% of the baseline mix in the Regional Industry Average EPD for that strength class.

- Where a lower volume of higher-strength concrete can be substituted for a standard concrete without the addition of other structural materials (for example, additional reinforcing steel), this volume and its associated GWP should be used in the CO_2e project calculation while the initial volume and GWP of the standard mix should be used to calculate the CO_2e baseline.

Source: https://www.tbs-sct.canada.ca/pol/doc-eng.aspx?id=32742

EPD guidance

- EPDs must follow the current versions of PCRs for Concrete and ISO 14025 Type III.
- Type II EPDs conforming to ISO 14021:2016 and ISO 21930:2017 may be used to substantiate the global warming potential (GWP) of materials used in a project if the Type II EPDs provide higher resolution than the available Type III EPDs and if the Type II EPDs were created using an independently verified tool.
- Where carbon capture utilization and storage technologies are used to reduce the GWP of a portion or all concrete supplied to a project, such as through carbon mineralization, a product-specific EPD shall be provided to substantiate the associated reduction in GHG emissions.

Source: https://www.tbs-sct.canada.ca/pol/doc-eng.aspx?id=32742

Appendix B

▾ Appendix B: Information for the Embodied Carbon Project Disclosure Template

The Embodied Carbon Project Disclosure Template must be completed for every applicable project to demonstrate that the requirements of the standard were met. The completed template is to be secured by the organization before project completion. The following information must be provided as part of completing the template.

Project Overview

The following project information must be included when completing an Embodied Carbon Project Disclosure Template.

- Name of client organization
- Name of client project
- Client project number
- Government of Canada Directory of Federal Real Property (DFRP) identification (if available)
- Prepared by (name of general contractor)
- Name of general contactor's company
- General contractor's email
- General contractor's phone number
- Date of preparation by contractor (day-month-year)
- Reviewed by (name of designer)
- Name of designer's company
- Designer's email
- Designer's phone number
- Date of review by designer (day-month-year)
- Project location (street address)
- Project location (city or town)
- Project location (province or territory)
- Asset archetype (for example, bridge, office, lab)
- Project footprint or building area (m²)
- Number of floors (if applicable)
- Project gross floor area (m², if applicable)
- Anticipated project completion date (day-month-year)
- Name of material supplier 1
- Material supplier 1 email
- Name of material supplier 2
- Material supplier 2 email
- Project narrative (designer notes)

Source: https://www.tbs-sct.canada.ca/pol/doc-eng.aspx?id=32742

Appendix B

Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations				GHG calculations for project mixes			Reductions in GHG emissions		
Element of building or structure	Special application requirement?	Reduction in volume of mix (yes or no)		Life cycle assessment (LCA) results table number	Baseline global warming potential (GWP) (kg CO2/m3) per mix		Baseline GHG emissions per mix (tonnes CO2)	EPD or mix design reference number for the mix provided	Adjusted volume (m3) Enter an adjusted volume only when "Yes" is selected under Reduction in volume (third column from the left under Ready-mix concrete used in project).	GWP (kg CO2/m3) of the mix provided	GHG emissions per mix provided	GHG emissions reduced compared to the baseline per mix provided	
(for example, walls, foundation)	(yes or no)	Select yes if the volume of a mix was reduced by increasing its compressive strength without adding other structural materials.	Compressive strength at 28 days (MPa)	(from the regional ASTM International Environmental Product Declaration (EPD))	(using equivalent compressive strength from the regional ASTM International EPD)	Volume (m3)	based on the baseline GWP and volume	(from the supplier's EPD)		(from the supplier's EPD)	(tonnes CO2)	(tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline
Element 1	Yes/No	Yes/No	xx	x	xxx.xx	xxx.x	**xxx.xx**	x	xxx.x	xxx.xx	**xxx.xx**	**xxx.xx**	**xx.x**
Element 2	Yes/No	Yes/No	xx	x	xxx.xx	xxx.x	**xxx.xx**	x	xxx.x	xxx.xx	**xxx.xx**	**xxx.xx**	**xx.x**
Element 3	Yes/No	Yes/No	xx	x	xxx.xx	xxx.x	**xxx.xx**	x	xxx.x	xxx.xx	**xxx.xx**	**xxx.xx**	**xx.x**
Element 4	Yes/No	Yes/No	xx	x	xxx.xx	xxx.x	**xxx.xx**	x	xxx.x	xxx.xx	**xxx.xx**	**xxx.xx**	**xx.x**
Project totals	N/A	Yes/No	N/A	N/A	N/A	**xxxx.x**	**xxx.xx**	N/A	**xxxx.x**	N/A	**xxx.xx**	**xxxx.xx**	**xx.x**
Reduction in GHG emissions related to the embodied carbon of ready-mix concrete supplied to the project (tonnes)						xxxx.xx	**Percentage reduction in GHG emissions related to the embodied carbon of ready-mix concrete supplied to the project**						xx.x

Source: https://www.tbs-sct.canada.ca/pol/doc-eng.aspx?id=32742

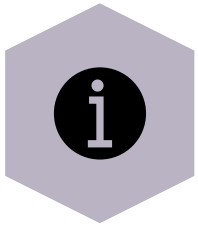
Appendix B

Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations				GHG calculations for project mixes			Reductions in GHG emissions		
Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no) Select yes if the volume of a mix was reduced by increasing its compressive strength without adding other structural materials.	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number (from the regional ASTM International Environmental Product Declaration (EPD))	Baseline global warming potential (GWP) (kg CO2/m3) per mix (using equivalent compressive strength from the regional ASTM International EPD)	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) Enter an adjusted volume only when "Yes" is selected under Reduction in volume (third column from the left under Ready-mix concrete used in project).	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline
Element 1	Yes/No	Yes/No	xx	x	xxx.xx	xxx.x	xxx.xx	x	xxx.x	xxx.xx	xxx.xx	xxx.xx	xx.x
Element 2	Yes/No	Yes/No	xx	x	xxx.xx	xxx.x	xxx.xx	x	xxx.x	xxx.xx	xxx.xx	xxx.xx	xx.x
Element 3	Yes/No	Yes/No	xx	x	xxx.xx	xxx.x	xxx.xx	x	xxx.x	xxx.xx	xxx.xx	xxx.xx	xx.x
Element 4	Yes/No	Yes/No	xx	x	xxx.xx	xxx.x	xxx.xx	x	xxx.x	xxx.xx	xxx.xx	xxx.xx	xx.x
Project totals	N/A	Yes/No	N/A	N/A	N/A	xxxx.x	xxx.xx	N/A	xxxx.x	N/A	xxx.xx	xxxx.xx	xx.x
Reduction in GHG emissions related to the embodied carbon of ready-mix concrete supplied to the project (tonnes)						xxxx.xx	Percentage reduction in GHG emissions related to the embodied carbon of ready-mix concrete supplied to the project						xx.x

{Introduce ICMS 3rd edition taxonomy for benchmarking purposes}

https://icms-coalition.org/

	B	C	D	E	F
			Ready-mix concrete used in project		
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]
2	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No
3	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No



Worked example

Sample Project

CIQS Elemental Summary

ELEMENT		Ratio to GFA	Element Cost Quantity	U
A	**SHELL**		1,067 m2	
A1	**SUBSTRUCTURE**			
A11	Foundations	1.000	1,067 m2	
A12	Basement Excavation	0.000	0 m3	
A13	Special Conditions	0.001	1 Sum	
A2	**STRUCTURE**			
A21	Lowest Floor Construction	11.947	12,747 m2	
A22	Upper Floor Construction	0.000	0 m2	
A23	Roof Construction	1.616	1,724 m2	
A3	**EXTERIOR ENCLOSURE**			
A31	Walls Below Grade	0.000	0 m2	
A32	Walls Above Grade	0.000	0 m2	
A33	Windows & Entrances	0.000	0 m2	
A34	Roof Covering	0.000	0 m2	
A35	Projections	0.000	0 Sum	
B	**INTERIORS**		1,067 m2	
B1	**PARTITIONS & DOORS**			
B2	**FINISHES**			
B21	Floor Finishes	1.000	1,067 m2	
B22	Ceiling Finishes	1.000	1,067 m2	
B23	Wall Finishes	0.000	0 m2	
B3	**FITTINGS & EQUIPMENT**			
B31	Fittings & Fixtures	1.000	1,067 m2	
B32	Equipment (In-Contract)	1.000	1,067 m2	
B33	Elevators	0.000	0 No.	
B34	Escalators	0.000	0 No.	
C	**SERVICES**		1,067 m2	
C1	**MECHANICAL**			
C11	Plumbing & Drainage	1.000	1,067 m2	
C12	Fire Protection	1.000	1,067 m2	
C13	HVAC	1.000	1,067 m2	
C14	Controls	1.000	1,067 m2	
C2	**ELECTRICAL**			
C21	Service & Distribution	1.000	1,067 m2	
C22	Lighting,Devices & Heating	1.000	1,067 m2	
C23	Systems & Ancillaries	1.000	1,067 m2	

Detailed Elemental Estimate

A1	**SUBSTRUCTURE**	**Quantity**
A11	**Foundations**	**1,067 m2**
1	Demolish existing asphalt for new foundation	1,067 m2
2	Perimeter grade beam GB1, 254 x 610 mm deep	138 m
	- Concrete, 30 MPa	21 m3
	- Rebar, 15 kg/m	2,070 kg
	- Formwork	168 m2
	- Void form, 150 mm shearmat	35 m2
	- Excavation & removal	21 m3
	- Ditto, workspace	42 m3
	- Backfill workspace with granular material	42 m3
3	Perimeter grade beam GB2, 457 x 610 mm deep	6 m
	- Concrete, 35 MPa	2 m3
	- Rebar, 25 kg/m	138 kg
	- Formwork	7 m2
	- Void form, 150 mm shearmat	3 m2
	- Excavation & removal	2 m3
	- Ditto, workspace	2 m3
	- Backfill workspace with granular material	2 m3
4	Extra over to exterior face of perimeter grade beam	84 m2
	- Galvanized flashing	7 m2
	- 13 flexcell	25 m2
	- 152 mm rigid insulation	84 m2
	- Damp proofing membrane	84 m2
	- 150 mm overlap wall air/vapour barrier	21 m2
5	Four pile caps, 1830 x 1830 x 610 mm deep	3 No.
	- Concrete, 32 MPa	6 m3
	- Rebar, 253 kg/ No.	759 kg
	- Formwork	13 m2
	- Void form, 150 mm shearmat	10 m2
	- Excavation & removal	6 m3
	- Ditto, workspace	3 m3
	- Backfill workspace with granular material	3 m3

Canada's FOCUS is on **concrete** for embodied and carbon emissions

To calculate carbon, you need concrete volume by strength.

You can consolidate all the concrete by strength

BUT

reporting by item or at least sub-element permits tracking for future benchmarking.

Regardless, the **quantity** of concrete is what matters and Quantity Surveyors are ideally suited to provide them and run the calculations.

Sample Project – Mapping Steps

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

Step 1:

1. Identify the concrete items in your estimate by item type and concrete strength

A1 SUBSTRUCTURE	Quantity
A11 Foundations	**1,067 m2**
1 Demolish existing asphalt for new foundation	1,067 m2
2 Perimeter grade beam GB1, 254 x 610 mm deep	138 m
- Concrete, 30 MPa	21 m3
- Rebar, 15 kg/m	2,070 kg
- Formwork	168 m2
- Void form, 150 mm shearmat	35 m2
- Excavation & removal	21 m3
- Ditto, workspace	42 m3
- Backfill workspace with granular material	42 m3
3 Perimeter grade beam GB2, 457 x 610 mm deep	6 m
- Concrete, 35 MPa	2 m3
- Rebar, 25 kg/m	138 kg
- Formwork	7 m2
- Void form, 150 mm shearmat	3 m2
- Excavation & removal	2 m3
- Ditto, workspace	2 m3
- Backfill workspace with granular material	2 m3

Sample Project – Mapping Steps

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

Step 2:

1. Identify the concrete items in your estimate by item type and concrete strength
2. Map the CIQS format, Uniformat or others to the appropriate ICMS code
    1. ICMS Level 3 (i.e., substructure)
    2. ICMS Level 4 (i.e., foundations)

A1 SUBSTRUCTURE	**Quantity**
A11 Foundations	**1,067 m2**
1 Demolish existing asphalt for new foundation	1,067 m2
2 Perimeter grade beam GB1, 254 x 610 mm deep	138 m
- Concrete, 30 MPa	21 m3
- Rebar, 15 kg/m	2,070 kg
- Formwork	168 m2
- Void form, 150 mm shearmat	35 m2
- Excavation & removal	21 m3
- Ditto, workspace	42 m3
- Backfill workspace with granular material	42 m3
3 Perimeter grade beam GB2, 457 x 610 mm deep	6 m
- Concrete, 35 MPa	2 m3
- Rebar, 25 kg/m	138 kg
- Formwork	7 m2
- Void form, 150 mm shearmat	3 m2
- Excavation & removal	2 m3
- Ditto, workspace	2 m3
- Backfill workspace with granular material	2 m3

Sample Project – Mapping Steps

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

Step 3:

1. Identify the concrete items in your estimate by item type and concrete strength
2. Map the CIQS format, Uniformat or others to the appropriate ICMS code
    1. ICMS Level 3 (i.e., substructure)
    2. ICMS Level 4 (i.e., foundations)
3. Input description by concrete strength

A1	**SUBSTRUCTURE**	**Quantity**
A11	**Foundations**	**1,067 m2**
1	Demolish existing asphalt for new foundation	1,067 m2
2	Perimeter grade beam GB1, 254 x 610 mm deep	138 m
	- Concrete, 30 MPa	21 m3
	- Rebar, 15 kg/m	2,070 kg
	- Formwork	168 m2
	- Void form, 150 mm shearmat	35 m2
	- Excavation & removal	21 m3
	- Ditto, workspace	42 m3
	- Backfill workspace with granular material	42 m3
3	Perimeter grade beam GB2, 457 x 610 mm deep	6 m
	- Concrete, 35 MPa	2 m3
	- Rebar, 25 kg/m	138 kg
	- Formwork	7 m2
	- Void form, 150 mm shearmat	3 m2
	- Excavation & removal	2 m3
	- Ditto, workspace	2 m3
	- Backfill workspace with granular material	2 m3

Sample Project – Mapping Steps

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

Step 3:

1. Identify the concrete items in your estimate by item type and concrete strength
2. Map the CIQS format, Uniformat or others to the appropriate ICMS code
    1. ICMS Level 3 (i.e., substructure)
    2. ICMS Level 4 (i.e., foundations)
3. Input description by concrete strength
4. Input quantity (volume) by concrete strength

		Quantity
A1	**SUBSTRUCTURE**	
A11	**Foundations**	**1,067 m2**
1	Demolish existing asphalt for new foundation	1,067 m2
2	Perimeter grade beam GB1, 254 x 610 mm deep	138 m
-	Concrete, 30 MPa	21 m3
-	Rebar, 15 kg/m	2,070 kg
-	Formwork	168 m2
-	Void form, 150 mm shearmat	35 m2
-	Excavation & removal	21 m3
-	Ditto, workspace	42 m3
-	Backfill workspace with granular material	42 m3
3	Perimeter grade beam GB2, 457 x 610 mm deep	6 m
-	Concrete, 35 MPa	2 m3
-	Rebar, 25 kg/m	138 kg
-	Formwork	7 m2
-	Void form, 150 mm shearmat	3 m2
-	Excavation & removal	2 m3
-	Ditto, workspace	2 m3
-	Backfill workspace with granular material	2 m3

Sample Project – Steps for Populating Data in ICMS Format

Recall Appendix B

Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations				GHG calculations for project mixes			Reductions in GHG emissions		
Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no) Select yes if the volume of a mix was reduced by increasing its compressive strength without adding other structural materials.	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number (from the regional ASTM International Environmental Product Declaration (EPD))	Baseline global warming potential (GWP) (kg CO2/m3) per mix (using equivalent compressive strength from the regional ASTM International EPD)	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) Enter an adjusted volume only when "Yes" is selected under Reduction in volume (third column from the left under Ready-mix concrete used in project).	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline
Element 1	Yes/No	Yes/No	xx	x	xxx.xx	xxx.x	xxx.xx	x	xxx.x	xxx.xx	xxx.xx	xxx.xx	xx.x
Element 2	Yes/No	Yes/No	xx	x	xxx.xx	xxx.x	xxx.xx	x	xxx.x	xxx.xx	xxx.xx	xxx.xx	xx.x
Element 3	Yes/No	Yes/No	xx	x	xxx.xx	xxx.x	xxx.xx	x	xxx.x	xxx.xx	xxx.xx	xxx.xx	xx.x
Element 4	Yes/No	Yes/No	xx	x	xxx.xx	xxx.x	xxx.xx	x	xxx.x	xxx.xx	xxx.xx	xxx.xx	xx.x
Project totals	N/A	Yes/No	N/A	N/A	N/A	xxxx.x	xxx.xx	N/A	xxxx.x	N/A	xxx.xx	xxxx.xx	xx.x
Reduction in GHG emissions related to the embodied carbon of ready-mix concrete supplied to the project (tonnes)						xxxx.xx	Percentage reduction in GHG emissions related to the embodied carbon of ready-mix concrete supplied to the project						xx.x

{Introduce ICMS 3rd edition taxonomy for benchmarking purposes}

https://icms-coalition.org/

	B	C	D	E	F
1			Ready-mix concrete used in project		
2	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]
3	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No
4	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No

Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

1. Enter ICMS Code

			Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations			
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
1	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No	30	Table 11	258.92	21.38	**5.54**
2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	**0.49**

Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

1. Enter ICMS Code
2. Enter ICMS Level 3

			Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations			
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
1	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No	30	Table 11	258.92	21.38	**5.54**
2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	**0.49**

Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

1. Enter ICMS Code
2. Enter ICMS Level 3
3. Enter details of item description

			Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations			
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
1	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No	30	Table 11	258.92	21.38	**5.54**
2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	**0.49**

Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

1. Enter ICMS Code
2. Enter ICMS Level 3
3. Enter details of item description
4. Special Application (assume no)

			Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations			
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
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2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	**0.49**

Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

1. Enter ICMS Code
2. Enter ICMS Level 3
3. Enter details of item description
4. Special Application (assume no)
5. Reduction in Volume (yes if volume of mix reduced by increasing its compressive strength without adding other structural materials)

			Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations			
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
1	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No	30	Table 11	258.92	21.38	**5.54**
2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	**0.49**

Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

1. Enter ICMS Code
2. Enter ICMS Level 3
3. Enter details of item description
4. Special Application (assume no)
5. Reduction in Volume (yes if volume of mix reduced by increasing its compressive strength without adding other structural materials)

6. Enter concrete strength

			Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations			
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
1	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No	30	Table 11	258.92	21.38	**5.54**
2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	**0.49**

Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

1. Enter ICMS Code
2. Enter ICMS Level 3
3. Enter details of item description
4. Special Application (assume no)
5. Reduction in Volume (yes if volume of mix reduced by increasing its compressive strength without adding other structural materials)

6. Enter concrete strength

			Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations			
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
1	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No	30	Table 11	258.92	21.38	**5.54**
2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	**0.49**

Sample Project – Steps for Populating Data in ICMS Format *EPDS*

Environmental Product Declaration

CONCRETEBC

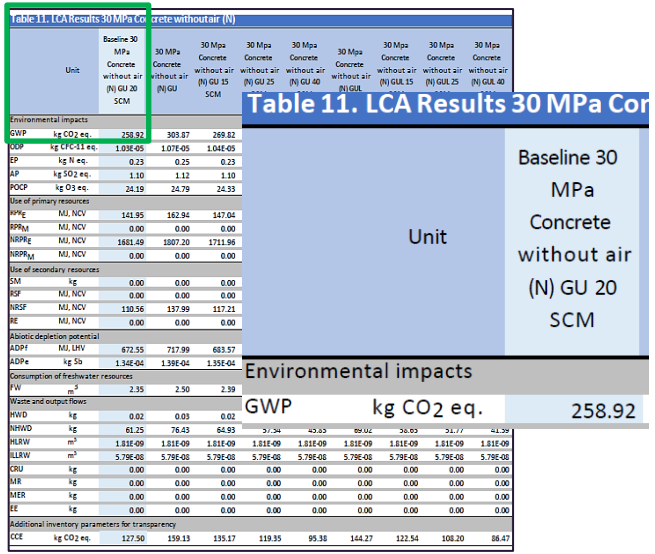
Concrete BC Member Industry-Wide EPD for

READY-MIXED CONCRETE

ASTM International Certified Environmental Product Declaration

Declared Product	This Environmental Product Declaration (EPD) covers concrete mixes produced by Concrete BC members.	
Declaration Owner	Concrete BC Suite 1300, 1500 West Georgia St. Vancouver, BC V6G 2Z6 Phone: 604-626-4141 Website: www.concretebc.ca	CONCRETEBC
Program Operator	ASTM International 100 Bar Harbor Drive West Conshohocken, PA 19428-2959, USA Website: www.astm.org	ASTM INTERNATIONAL Helping our world work better
LCA and EPD Developer	Athena Sustainable Materials Institute 280 Albert Street, Suite 404 Ottawa, ON K1P 5G8, Canada Website: www.athenasmi.org	Athena Sustainable Materials Institute
Core PCR	ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products	
Sub-category PCR	NSF International Product Category Rule (PCR) for Concrete Version 2.1 (August 2021), Verified by Thomas P. Gloria, Ph.D., Industrial Ecology Consultants	
Independent LCA Reviewer and EPD Verifier	Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025:2006 ☐ Internal x☐ External	
	Thomas P. Gloria, Ph.D., Industrial Ecology Consultants, ASTM International	
Date of Issue	July 27, 2022	
Period of Validity	5 Years – Valid until July 27, 2027	
EPD Number	EPD 348	

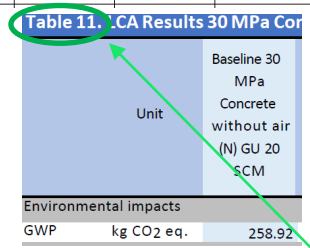
7. Enter LCA Table No. from regional ASTM International EPD



Unit	Baseline 30 MPa Concrete without air (N) GU 20 SCM
Environmental impacts	
GWP kg CO_2 eq.	258.92

Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3



6. Enter concrete strength
7. Enter LCA Table No. from regional ASTM International EPD

			Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations			
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
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Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
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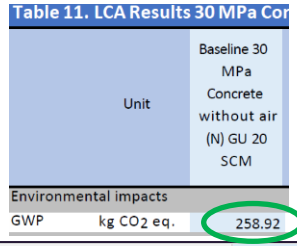

Table 11. LCA Results 30 MPa Cor

	Unit	Baseline 30 MPa Concrete without air (N) GU 20 SCM
Environmental impacts		
GWP	kg CO_2 eq.	258.92

6. Enter concrete strength
7. Provide ASTM International EPD Table used
8. Enter baseline GWP for 30 MPa from Table 11

			Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations			
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
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2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	**0.49**

Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
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Table 11. LCA Results 30 MPa Cor

	Unit	Baseline 30 MPa Concrete without air (N) GU 20 SCM
Environmental impacts		
GWP	kg CO_2 eq.	258.92

6. Enter concrete strength
7. Provide ASTM International EPD Table used
8. Enter baseline GWP for 30 MPa from Table 11
9. Enter volume of concrete from estimate

			Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations			
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
1	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No	30	Table 11	258.92	21.38	**5.54**
2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	**0.49**

Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

Table 11. LCA Results 30 MPa Cor

	Unit	Baseline 30 MPa Concrete without air (N) GU 20 SCM
Environmental impacts		
GWP	kg CO_2 eq.	258.92

6. Enter concrete strength
7. Provide ASTM International EPD Table used
8. Enter baseline GWP for 30 MPa from Table 11
9. Enter volume of concrete from estimate
10. Baseline GHG = $\frac{\text{GWP x volume}}{1000} = \frac{258.92 \times 21.38}{1000}$ =5.54 tonnes CO_2

			Ready-mix concrete used in project			Project mix strengths	Baseline greenhouse gas (GHG) calculations			
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
1	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No	30	Table 11	258.92	21.38	**5.54**
2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	**0.49**

Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

Table 11. LCA Results 30 MPa Cor

	Unit	Baseline 30 MPa Concrete without air (N) GU 20 SCM
Environmental impacts		
GWP	kg CO_2 eq.	258.92

10. Baseline GHG (per previous slide)

= GWP x volume = 258.92 x 21.38 =5.54 tonnes CO2

1000 1000

Project mix strengths	Baseline greenhouse gas (GHG) calculations				GHG calculations for project mixes			Reductions in GHG emissions		
Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline
30	Table 11	258.92	21.38	**5.54**	MixGC30E0XB1C08 (North Vancouver Plant)	0.00	231.00	**4.94**	**0.60**	**10.78%**
35	Table 15	293.75	1.67	**0.49**	Mix GC35E0XB1C08 (North Vancouver Plant)	0.00	275.00	**0.46**	**0.03**	**6.38%**

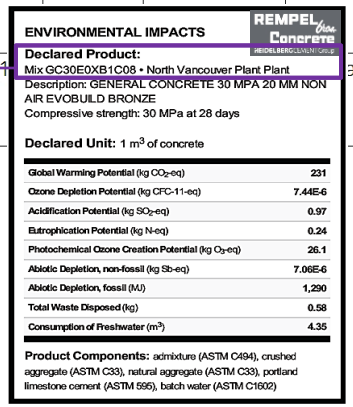
Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11			ations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

Table 11. LCA Results 30 MPa Cor

Unit	Baseline 30 MPa Concrete without air (N) GU 20 SCM
Environmental impacts	
GWP kg CO_2 eq.	258.92

11. Enter EPD or mix design reference number from the supplier



ENVIRONMENTAL IMPACTS

REMPEL Your Concrete

Declared Product:
Mix GC30E0XB1C08 • North Vancouver Plant Plant
Description: GENERAL CONCRETE 30 MPA 20 MM NON AIR EVOBUILD BRONZE
Compressive strength: 30 MPa at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	231
Ozone Depletion Potential (kg CFC-11-eq)	7.44E-6
Acidification Potential (kg SO_2-eq)	0.97
Eutrophication Potential (kg N-eq)	0.24
Photochemical Ozone Creation Potential (kg O_3-eq)	26.1
Abiotic Depletion, non-fossil (kg Sb-eq)	7.06E-6
Abiotic Depletion, fossil (MJ)	1,290
Total Waste Disposed (kg)	0.58
Consumption of Freshwater (m^3)	4.35

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

Additional detail and impacts are reported on page three of this EPD

Project mix strengths	Baseline greenhouse gas (GHG) calculations				GHG calculations for project mixes			Reductions in GHG emissions		
Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline
30	Table 11	258.92	21.38	**5.54**	MixGC30E0XB1C08 (North Vancouver Plant)	0.00	231.00	**4.94**	**0.60**	**10.78%**
35	Table 15	293.75	1.67	**0.49**	Mix GC35E0XB1C08 (North Vancouver Plant)	0.00	275.00	**0.46**	**0.03**	**6.38%**

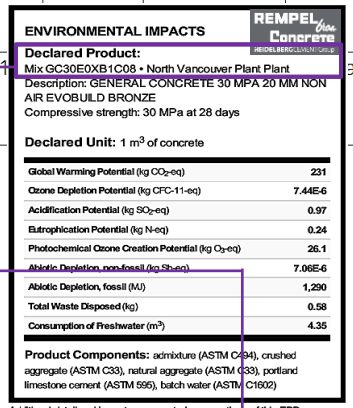
Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11			ations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

Table 11. LCA Results 30 MPa Cor

Unit	Baseline 30 MPa Concrete without air (N) GU 20 SCM
Environmental impacts	
GWP kg CO_2 eq.	258.92

11. Enter EPD or mix design reference number from the supplier
12. Enter adjusted volume (assume 0)



ENVIRONMENTAL IMPACTS

REMPEL Ultra Concrete

Declared Product:
Mix GC30E0XB1C08 • North Vancouver Plant Plant
Description: GENERAL CONCRETE 30 MPA 20 MM NON AIR EVOBUILD BRONZE
Compressive strength: 30 MPa at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	231
Ozone Depletion Potential (kg CFC-11-eq)	7.44E-6
Acidification Potential (kg SO_2-eq)	0.97
Eutrophication Potential (kg N-eq)	0.24
Photochemical Ozone Creation Potential (kg O_3-eq)	26.1
Abiotic Depletion, non-fossil (kg Sb-eq)	7.06E-6
Abiotic Depletion, fossil (MJ)	1,290
Total Waste Disposed (kg)	0.58
Consumption of Freshwater (m^3)	4.35

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

Additional detail and impacts are reported on page [illegible] of this EPD

Project mix strengths	Baseline greenhouse gas (GHG) calculations				GHG calculations for project mixes			Reductions in GHG emissions		
Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline
30	Table 11	258.92	21.38	**5.54**	MixGC30E0XB1C08 (North Vancouver Plant)	0.00	231.00	**4.94**	**0.60**	**10.78%**
35	Table 15	293.75	1.67	**0.49**	Mix GC35E0XB1C08 (North Vancouver Plant)	0.00	275.00	**0.46**	**0.03**	**6.38%**

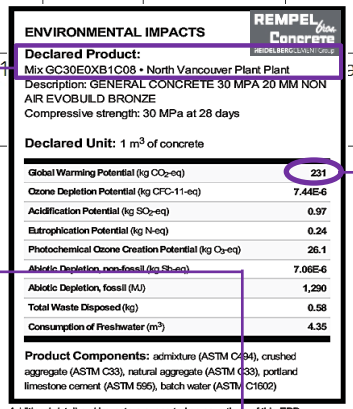
Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11			ations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

Table 11. LCA Results 30 MPa Cor

Unit	Baseline 30 MPa Concrete without air (N) GU 20 SCM
Environmental impacts	
GWP kg CO_2 eq.	258.92

11. Enter EPD or mix design reference number from the supplier
12. Enter adjusted volume (assume 0)



ENVIRONMENTAL IMPACTS

REMPEL Ultra Concrete

Declared Product:
Mix GC30E0XB1C08 • North Vancouver Plant Plant
Description: GENERAL CONCRETE 30 MPA 20 MM NON AIR EVOBUILD BRONZE
Compressive strength: 30 MPa at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	231
Ozone Depletion Potential (kg CFC-11-eq)	7.44E-6
Acidification Potential (kg SO_2-eq)	0.97
Eutrophication Potential (kg N-eq)	0.24
Photochemical Ozone Creation Potential (kg O_3-eq)	26.1
Abiotic Depletion, non-fossil (kg Sb-eq)	7.06E-6
Abiotic Depletion, fossil (MJ)	1,290
Total Waste Disposed (kg)	0.58
Consumption of Freshwater (m^3)	4.35

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

Additional detail and impacts are reported on page [illegible] of this EPD

13. Enter GWP from supplier

Project mix strengths	Baseline greenhouse gas (GHG) calculations				GHG calculations for project mixes			Reductions in GHG emissions		
Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline
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35	Table 15	293.75	1.67	**0.49**	Mix GC35E0XB1C08 (North Vancouver Plant)	0.00	275.00	**0.46**	**0.03**	**6.38%**

Sample Project – Steps for Populating Data in ICMS Format

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
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Table 11. LCA Results 30 MPa Cor

	Unit	Baseline 30 MPa Concrete without air (N) GU 20 SCM
Environmental impacts		
GWP	kg CO_2 eq.	258.92

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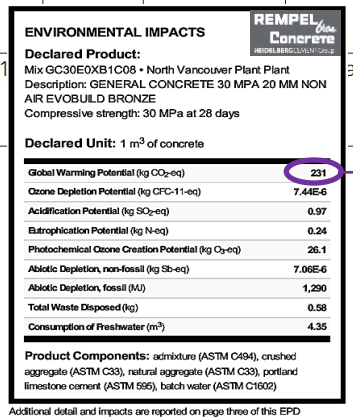
12. Enter adjusted volume (assume 0)



ENVIRONMENTAL IMPACTS

REMPEL Ready Concrete

Declared Product:
Mix GC30E0XB1C08 • North Vancouver Plant Plant
Description: GENERAL CONCRETE 30 MPA 20 MM NON AIR EVOBUILD BRONZE
Compressive strength: 30 MPa at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	231
Ozone Depletion Potential (kg CFC-11-eq)	7.44E-6
Acidification Potential (kg SO_2-eq)	0.97
Eutrophication Potential (kg N-eq)	0.24
Photochemical Ozone Creation Potential (kg O_3-eq)	26.1
Abiotic Depletion, non-fossil (kg Sb-eq)	7.06E-6
Abiotic Depletion, fossil (MJ)	1,290
Total Waste Disposed (kg)	0.58
Consumption of Freshwater (m^3)	4.35

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

Additional detail and impacts are reported on page three of this EPD

13. Enter GWP from supplier
14. Reduction GHG = 4.94 = 21.38 m3 x 231 kg CO2/m3 / 1000 to convert kg to tonnes

Project mix strengths	Baseline greenhouse gas (GHG) calculations				GHG calculations for project mixes			Reductions in GHG emissions		
Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline
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Sample Project – Steps for Populating Data in ICMS Format

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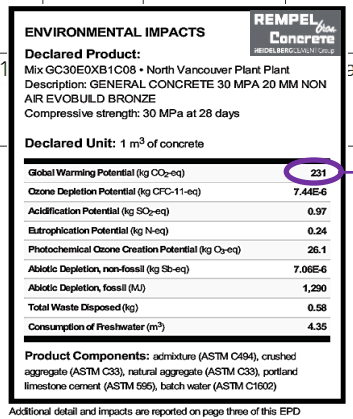

ENVIRONMENTAL IMPACTS

REMPEL Ready Concrete

Declared Product:
Mix GC30E0XB1C08 • North Vancouver Plant Plant
Description: GENERAL CONCRETE 30 MPA 20 MM NON AIR EVOBUILD BRONZE
Compressive strength: 30 MPa at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	231
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Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline
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Sample Project – Steps for Populating Data in ICMS Format

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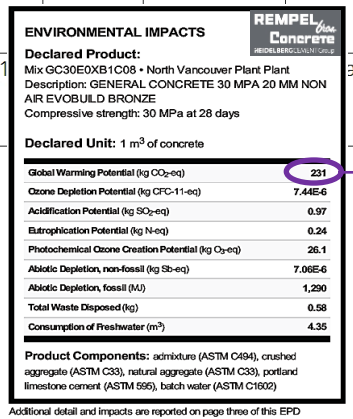

ENVIRONMENTAL IMPACTS

REMPEL Ready Concrete

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Declared Unit: 1 m^3 of concrete

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14. Reduction GHG = 4.94 = 21.38 m3 x 231 kg CO2/m3 / 1000 to convert kg to tonnes
15. Variance GHGe = 5.54 - 4.94 = 0.60 tonnes CO2
16. %Variance GHGe = 0.60 tonnes CO2 x 100% = 10.78% / 5.54 tonnes CO2

Project mix strengths	Baseline greenhouse gas (GHG) calculations				GHG calculations for project mixes			Reductions in GHG emissions		
Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline
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Sample Project – Key Findings

KEY FINDINGS FOR 1 ITEM:

Baseline GHG	5.54 tonnes CO2
GHG Emissions per mix	4.94 tonnes CO2
GHG Emissions Reduction	0.60 tonnes CO2
% Reduction	10.78%

OBJECTIVE is to find cumulative Reduction for the Project

14. Reduction GHG = 4.94 = $\frac{21.38 \text{ m3} \times 231 \text{ kg CO2/m3}}{1000 \text{ to convert kg to tonnes}}$

15. Variance GHGe = 5.54 - 4.94 = 0.60 tonnes CO2

16. %Variance GHGe = $\frac{0.60 \text{ tonnes CO2}}{5.54 \text{ tonnes CO2}} \times 100\% = 10.78\%$

Project mix strengths	Baseline greenhouse gas (GHG) calculations				GHG calculations for project mixes			Reductions in GHG emissions		
Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline
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Sample Project – Key Findings

KEY FINDINGS FOR 1 ITEM:

Baseline GHG	5.54 tonnes CO2
GHG Emissions per mix	4.94 tonnes CO2
GHG Emissions Reduction	0.60 tonnes CO2
% Reduction	10.78%

OBJECTIVE is to find cumulative Reduction for the Project

REQUIRED INFORMATION:

Reporting Standard	ICMS
Volume of Concrete by Strength	ESTIMATE
EPDs for Baseline and Product	CHALLENGE

14. Reduction GHG = 4.94 = $\frac{21.38 \text{ m3} \times 231 \text{ kg CO2/m3}}{1000 \text{ to convert kg to tonnes}}$

15. Variance GHGe = 5.54 - 4.94 = 0.60 tonnes CO2

16. %Variance GHGe = $\frac{0.60 \text{ tonnes CO2}}{5.54 \text{ tonnes CO2}} \times 100\% = 10.78\%$

Project mix strengths	Baseline greenhouse gas (GHG) calculations				GHG calculations for project mixes			Reductions in GHG emissions		
Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline
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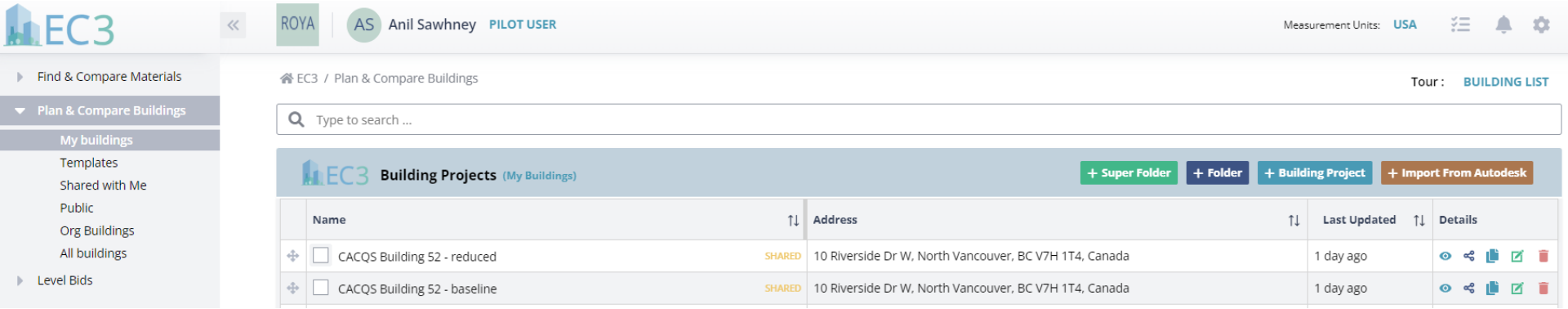
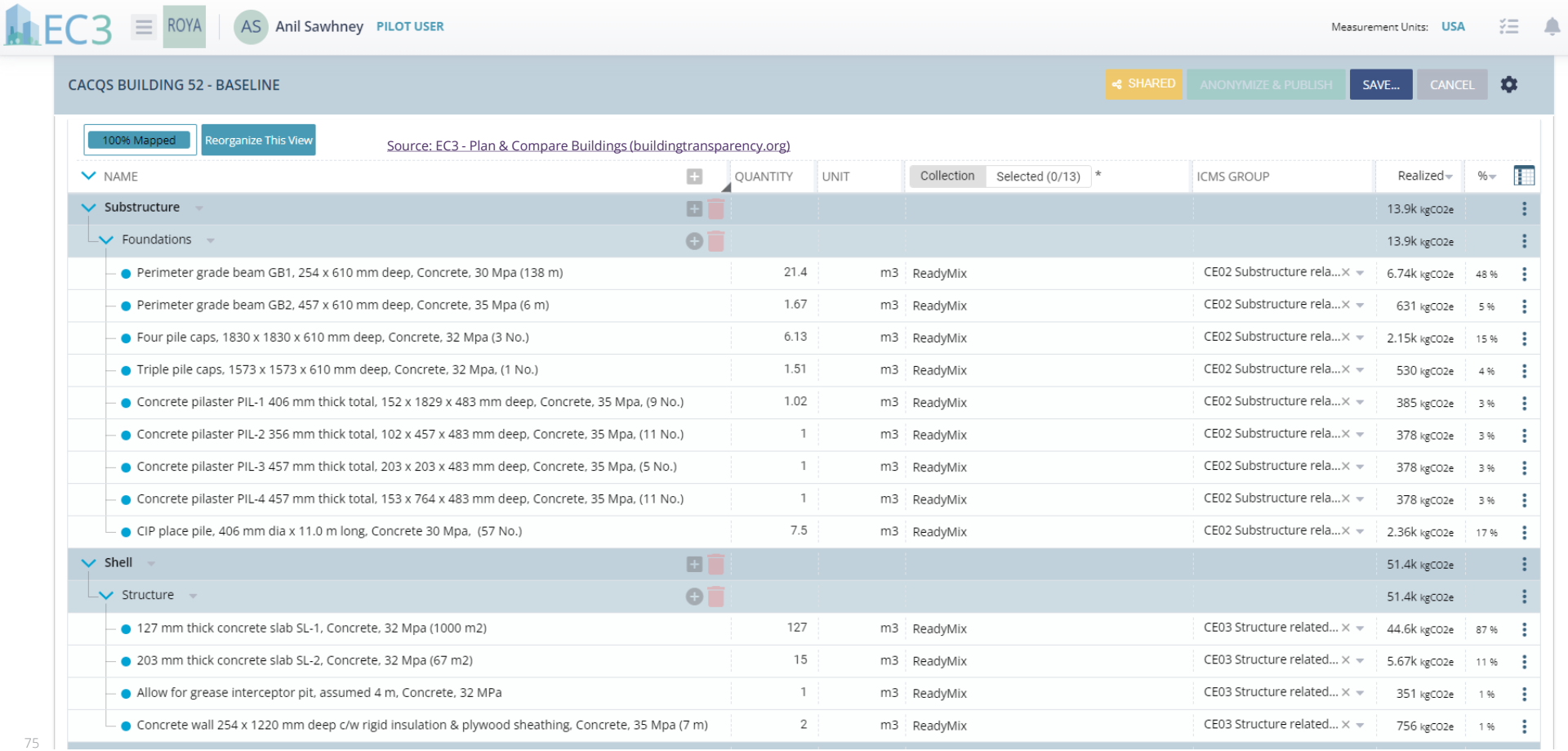
Baseline and reduced projects in EC3

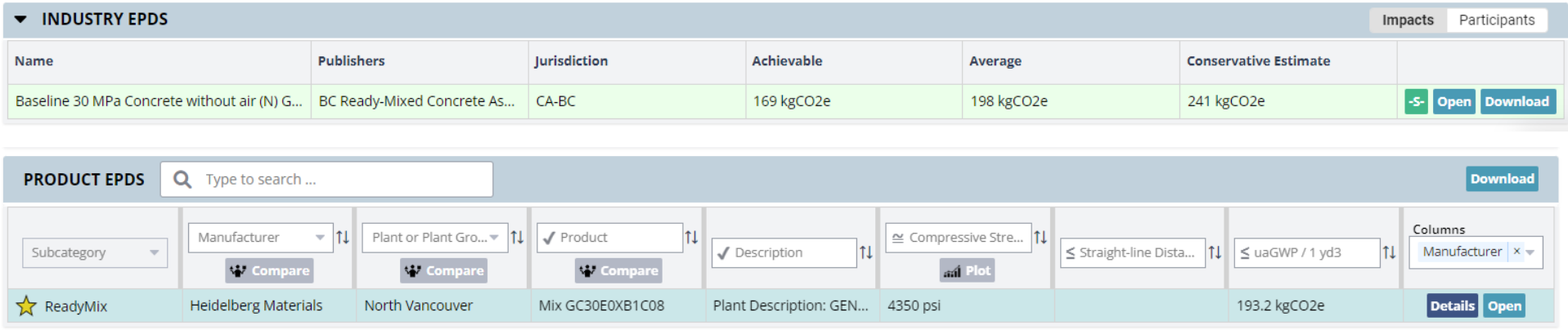


Source: EC3 - Plan & Compare Buildings (buildingtransparency.org)

Add elements and assign ICMS classification



Search Industry and Product EPDs by location and concrete type



INDUSTRY EPDS — Impacts | Participants

Name	Publishers	Jurisdiction	Achievable	Average	Conservative Estimate	
Baseline 30 MPa Concrete without air (N) G...	BC Ready-Mixed Concrete As...	CA-BC	169 kgCO2e	198 kgCO2e	241 kgCO2e	-S- Open Download

PRODUCT EPDS — Type to search ... — Download

Subcategory	Manufacturer	Plant or Plant Gro...	Product	Description	Compressive Stre...	≤ Straight-line Dista...	≤ uaGWP / 1 yd3	Columns: Manufacturer
	Compare	Compare	Compare		Plot			
ReadyMix	Heidelberg Materials	North Vancouver	Mix GC30E0XB1C08	Plant Description: GEN...	4350 psi		193.2 kgCO2e	Details Open

Source: EC3 - Plan & Compare Buildings (buildingtransparency.org)

Export results for completing Appendix B

EC3 Building Project	CACQS Building 52 - reduced		**Date of Report**	2023-09-17								
Level of Development	LOD 300: Detailed Design		**Source of Data**	Construction Estimate								
Area	*1,067*	*m2*	**Project Notes**	**Project Record Created by asawhney@rics.org on 24/03/2023,**	*66.7*	*61.6*	*42.2*		*33.6*	*kgCO2e/m2*		
Totals	*21*				*71139.8*	*65735.3*	*45032.7*	*37%*	*35847.4*	*kgCO2e*		
Subassembly	**Element**	**Material**	**Quantity**	**unit**	**Masterformat**	**Baseline (kgCO2e)**	**Conservative (kgCO2e)**	**Realized (kgCO2e)**	***Reduction from Baseline***	**Achievable (kgCO2e)**	**GWP unit**	**Selected Material Manufacturer**
Substructure->Foundations	Perimeter grade beam GB1,	ReadyMix: Lightweight - No; Jurisdiction - C	21.4	1 m3	03 30 00 Cast-in-Place Concrete	8124.4	7507.2	5403.5	*33%*	4093.9	kgCO2e	Heidelberg Materials
Substructure->Foundations	Perimeter grade beam GB2,	ReadyMix: Lightweight - No; Jurisdiction - C	1.7	1 m3	03 30 00 Cast-in-Place Concrete	634.6	586.4	503.3	*21%*	319.8	kgCO2e	Heidelberg Materials
Substructure->Foundations	Four pile caps, 1830 x 1830 x	ReadyMix: Lightweight - No; Jurisdiction - C	6.1	1 m3	03 30 00 Cast-in-Place Concrete	2329.4	2152.4	1445.1	*38%*	1173.8	kgCO2e	
Substructure->Foundations	Triple pile caps, 1573 x 1573	ReadyMix: Lightweight - No; Jurisdiction - C	1.5	1 m3	03 30 00 Cast-in-Place Concrete	573.8	530.2	356.0	*38%*	289.1	kgCO2e	
Substructure->Foundations	Concrete pilaster PIL-1 406 m	ReadyMix: Lightweight - No; Jurisdiction - C	1.0	1 m3	03 30 00 Cast-in-Place Concrete	387.6	358.2	307.4	*21%*	195.3	kgCO2e	Heidelberg Materials
Substructure->Foundations	Concrete pilaster PIL-2 356 m	ReadyMix: Lightweight - No; Jurisdiction - C	1.0	1 m3	03 30 00 Cast-in-Place Concrete	380.0	351.1	301.4	*21%*	191.5	kgCO2e	Heidelberg Materials
Substructure->Foundations	Concrete pilaster PIL-3 457 m	ReadyMix: Lightweight - No; Jurisdiction - C	1.0	1 m3	03 30 00 Cast-in-Place Concrete	380.0	351.1	301.4	*21%*	191.5	kgCO2e	Heidelberg Materials
Substructure->Foundations	Concrete pilaster PIL-4 457 m	ReadyMix: Lightweight - No; Jurisdiction - C	1.0	1 m3	03 30 00 Cast-in-Place Concrete	380.0	351.1	301.4	*21%*	191.5	kgCO2e	Heidelberg Materials
Substructure->Foundations	CIP place pile, 406 mm dia x	ReadyMix: Lightweight - No; Jurisdiction - C	7.5	1 m3	03 30 00 Cast-in-Place Concrete	2850.0	2633.5	1895.5	*33%*	1436.1	kgCO2e	Heidelberg Materials
Shell->Structure	127 mm thick concrete slab S	ReadyMix: Lightweight - No; Jurisdiction - C	127.0	1 m3	03 30 00 Cast-in-Place Concrete	48260.0	44593.7	29940.2	*38%*	24318.2	kgCO2e	
Shell->Structure	203 mm thick concrete slab S	ReadyMix: Lightweight - No; Jurisdiction - C	15.0	1 m3	03 30 00 Cast-in-Place Concrete	5700.0	5267.0	3536.2	*38%*	2872.2	kgCO2e	
Shell->Structure	Allow for grease interceptor	ReadyMix: Lightweight - No; Jurisdiction - C	1.0	1 m3	03 30 00 Cast-in-Place Concrete	380.0	351.1	235.7	*38%*	191.5	kgCO2e	
Shell->Structure	Concrete wall 254 x 1220 mm	ReadyMix: Lightweight - No; Jurisdiction - C	2.0	1 m3	03 30 00 Cast-in-Place Concrete	760.0	702.3	505.5	*33%*	383.0	kgCO2e	Heidelberg Materials
A5 Construction	e.g. mains supply	Electricity	0.0	1 kWh	00 00 00 No Masterformat Code		0.0	0.0	*#DIV/0!*	0.0	kgCO2e	
A5 Construction	e.g. heating, generator	NaturalGas	0.0	1 ng_scf	00 00 00 No Masterformat Code		0.0	0.0	*#DIV/0!*	0.0	kgCO2e	
A5 Construction	e.g. trucks, generators	Diesel	0.0	1 gal	00 00 00 No Masterformat Code		0.0	0.0	*#DIV/0!*	0.0	kgCO2e	
A5 Construction	e.g. vehicles	Gasoline	0.0	1 gal	00 00 00 No Masterformat Code		0.0	0.0	*#DIV/0!*	0.0	kgCO2e	

Source: EC3 - Plan & Compare Buildings (buildingtransparency.org)

Additional issues to consider

01

Increase availability of EPDs in Canada

02

Address uncertainty and provide guidance in the standard

03

Adopt ICMS 3rd edition as a classification system

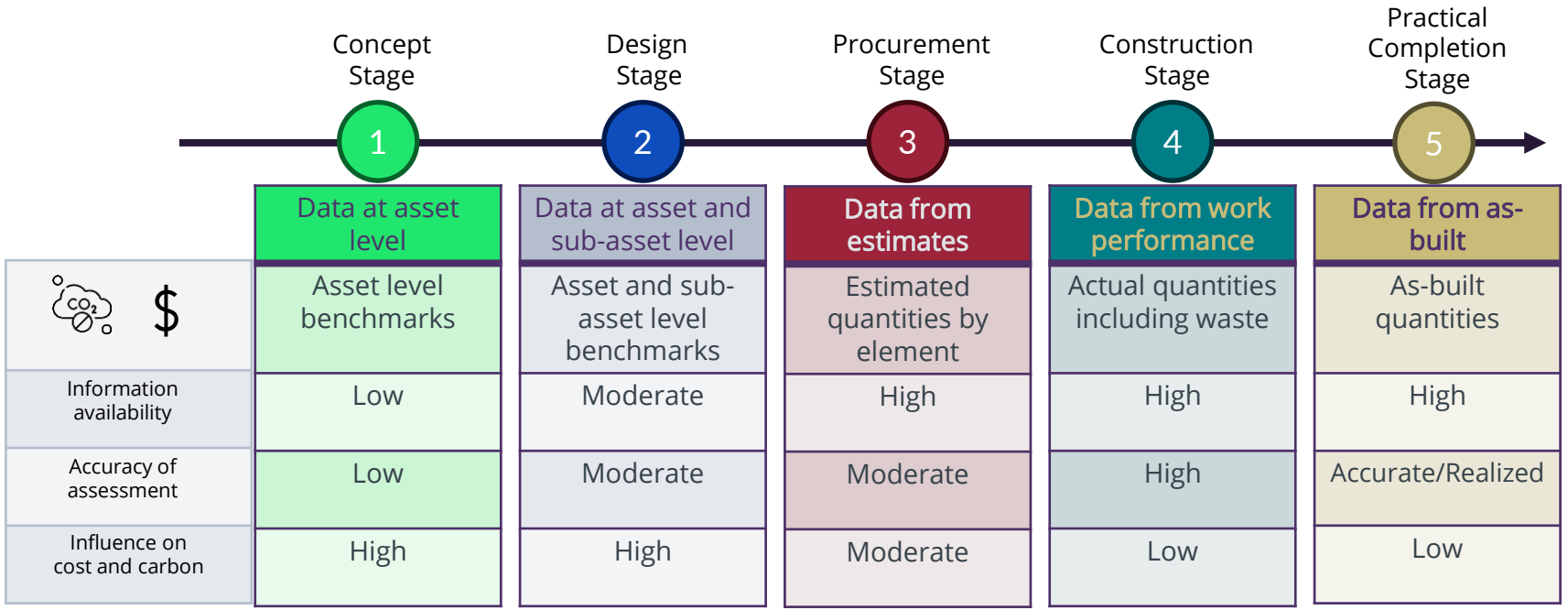
04

Consider modules beyond A1 to A3

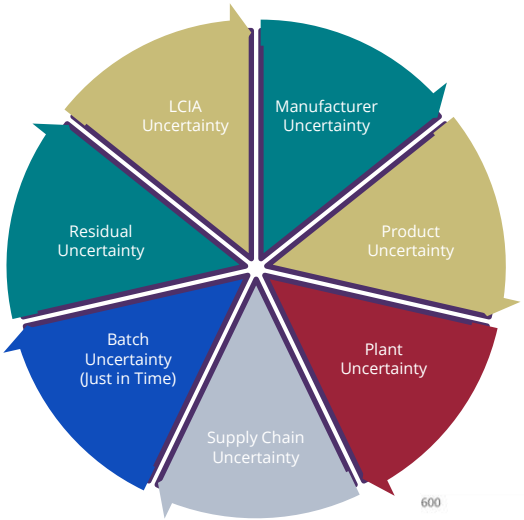
05

Develop an online benchmarking database using Appendix B

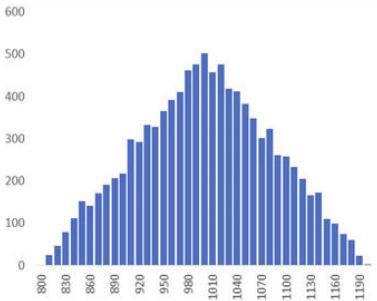
Sounds familiar!

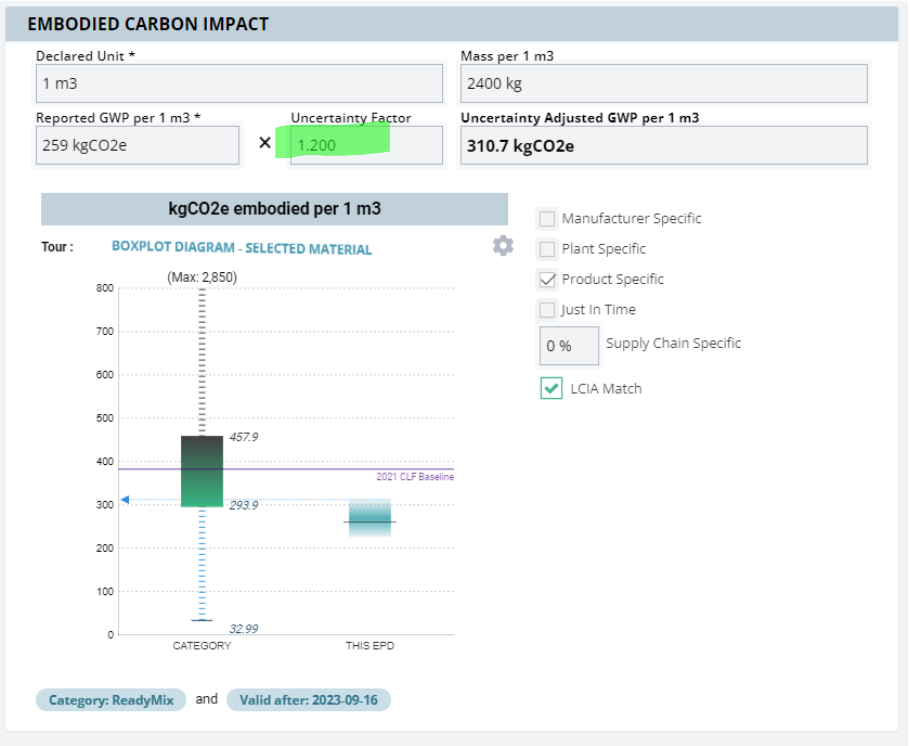


Managing uncertainty



Monte Carlo simulation

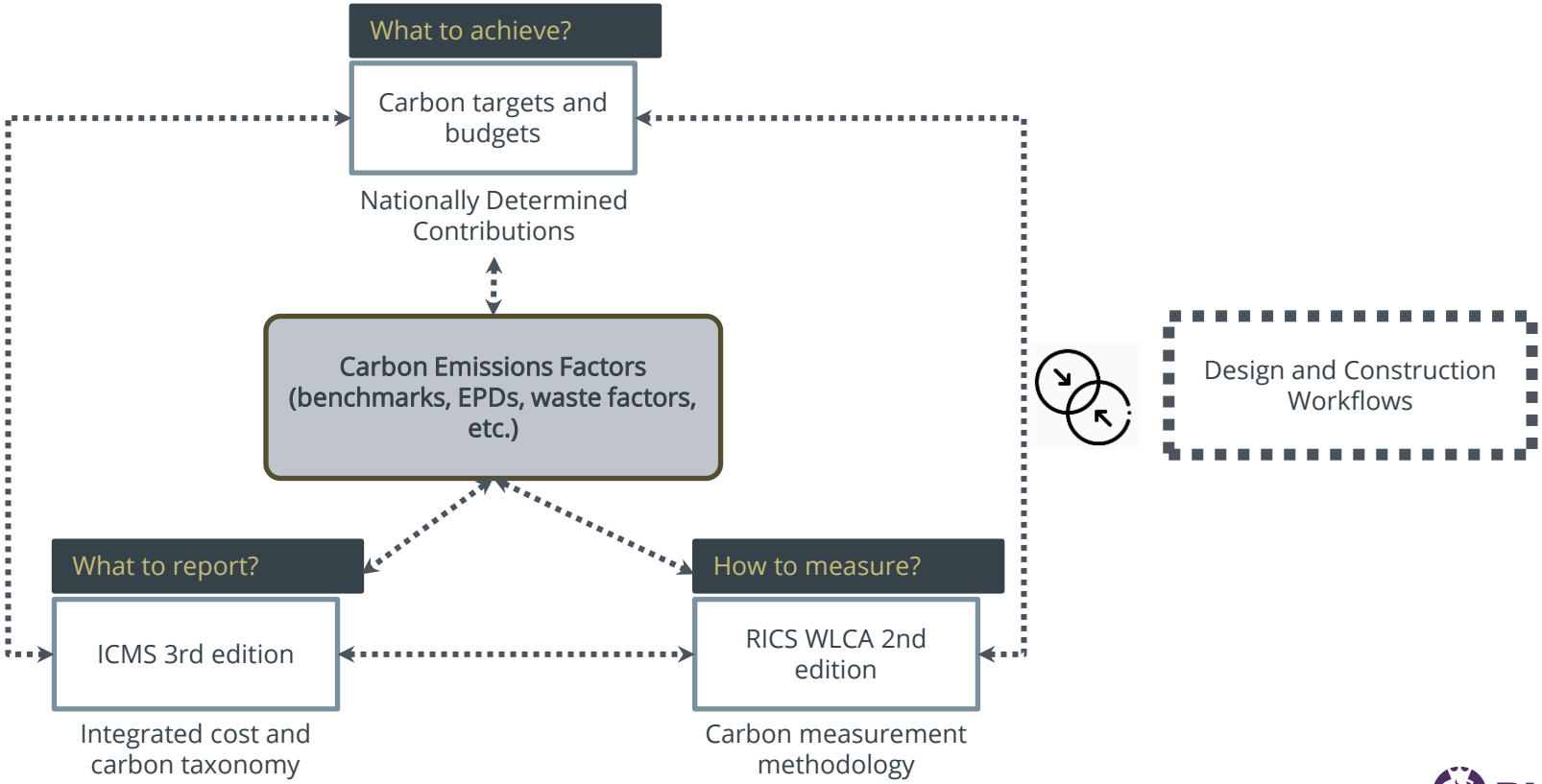




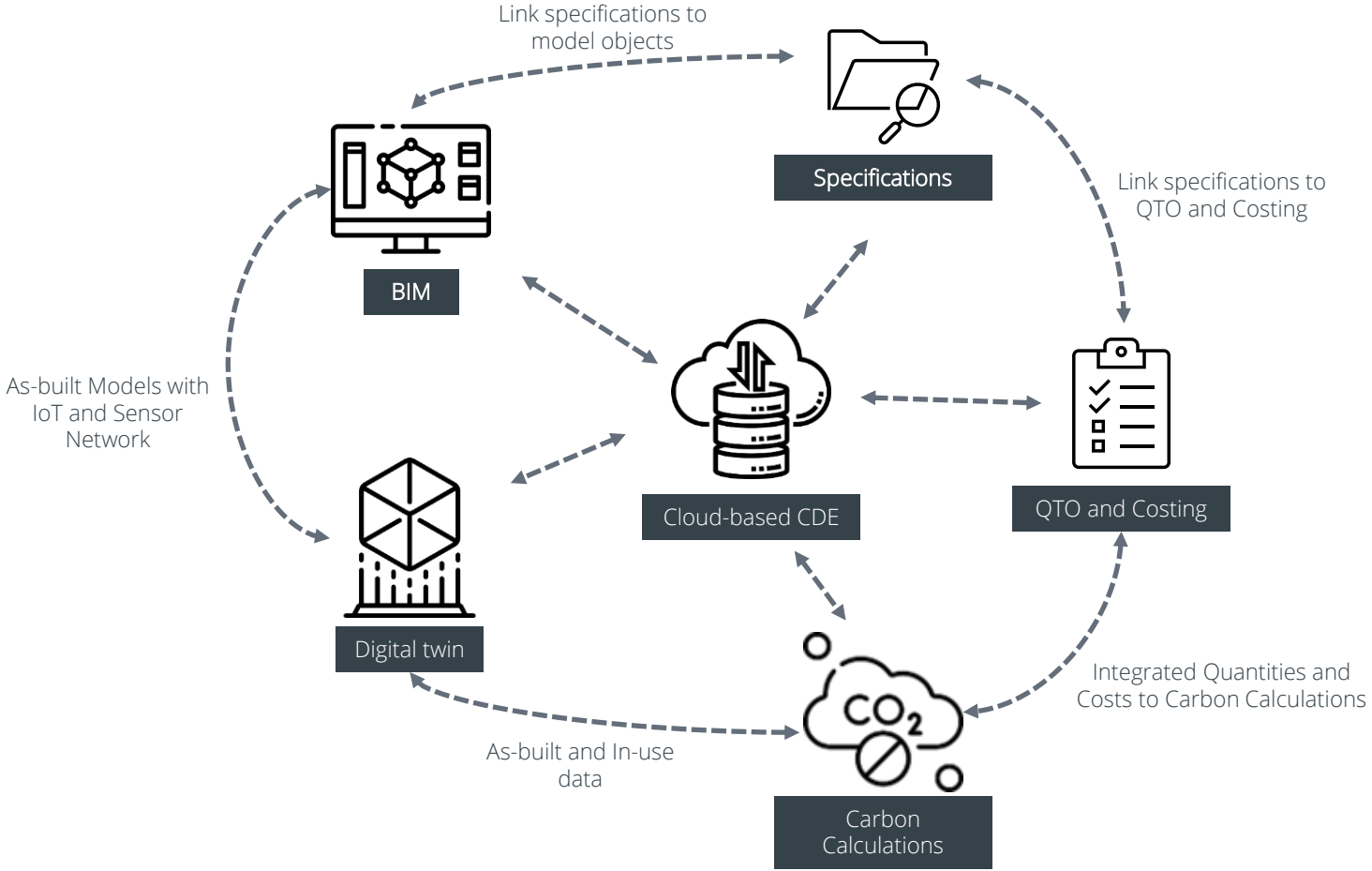
Source: https://buildingtransparency.org/ec3/methodology/uncertainty

Closing, feedback, and questions

Data and information



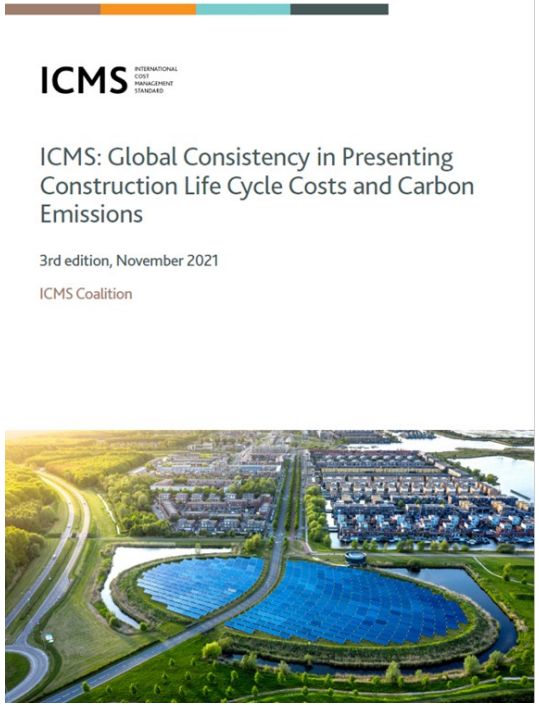
Integrating workflows

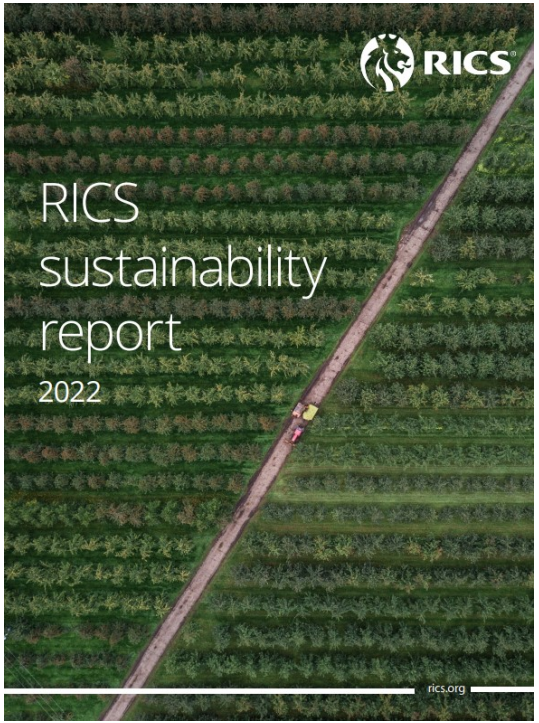


Things We Need to Address

- Carbon is the loudest but not the only voice
- Data and digital tools central to decarbonization
- Common principles and standards are needed
- Information management is a key driver
- Information about emerging laws, regulations, and policies
- Focus on performance and outcomes (reduce emissions, reduce waste, etc.)
- Role of cost managers (QSs) and others is crucial

- Questions.
- Thank you for attending!
- Additional resources





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