Environmental Product Declaration

Environmental Product Declaration for various ready mix concrete products produced by Holcim México Operaciones S.A. de C.V. at their Puebla facility in Puebla, México

ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers concrete products produced by Holcim México Operaciones S.A. de C.V.. Declared unit: 1 m3 of concrete
Declaration Owner:	Holcim México Operaciones S.A. de C.V. Av. Prolongación Vasco de Quiroga #4800 Torre II Ofic. 101 Piso 1, Santa Fe Cuajimalpa de Morelos Ciudad de México, México www.holcim.com.mx
Program Operator:	Labeling Sustainability 11670 W Sunset Blvd. Los Angeles, CA www.labelinsustainability.com
Product Category Rule:	Core PCR: ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services SubPCR: NSF International (March 2020). Product Category Rul (PCR) for Environmental Product Declarations (EPD) PCR for Concrete, v2.1 Sub PCR Program Operator: NSF International Sub-category PCR review was conducted by: Thomas P. Gloria, Ph. D. of Industrial Ecology Consultants: 35 Bracebridge, Rd., Newton, MA 02459-1728, t.gloria@industrial-ecology.com. Dr. Michael Overcash of Environmental Clarity: 2908 Chipmunk Lane, Raleigh, NC 27607-3117, mrovercash@earthlink.net. Mr. Bill Stough of Sustainable Research Group: PO Box 1684, Grand Rapids, MI 49501-1684, bstough@sustainableresearchgroup.com. Mr. Jack Geilbig, EcoForm: 2624 Abelia Way, Suite 611, Knoxville, TN 37931, jgeilbig@ecoform.com.
Independent LCA Reviewer and EPD Verifier:	This EPD was independently verified in accordance with ISO 14025 and ISO 21930. The life cycle assessment was independently reviewed in accordance ISO 14044 and the referenced PCR. Independent verification of the declaration, according to ISO 14025:2006 Internal ☐ ; External X Third Party Verifier Geoffrey Guest, Certified 3rd Party Verifier under the International EPD Program (www.environdec.com), CSA Group (www.csaregistries.ca)
Date of Issue:	13 July 2023
Period of Validity:	5 years; valid until 13 July 2028
EPD Number:	acd33cb8-fa84-427d-958a-ed1b7b167f5a

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COMPANY DESCRIPTION

Holcim Mexico produces and markets cement, ready-mix concrete, and other products and services for construction. The company has a nationwide presence through 7 cement plants with a current installed capacity to produce 12.6 million tons per year, 23 cement distribution centers, two maritime terminals, 1 Corporate Office, plus 35 ready-mix concrete plants, seven platforms, and a Geocycle transfer center, 26 commercial partners with more than 90 ready-mix concrete plants, more than 500 mixing pots, one aggregates plant and a Technological Innovation Center for Construction (CITEC).

Sustainable Development is an integral part of Lafarge Holcim's strategy around the world. Holcim Mexico has a clear vision of the future it wants for our country, which contributes to its development. Holcim Mexico's main objective is to create value. Creating value ensures long-term business success in covering the triple bottom line (i.e., social, economic, environmental values). Finally, good operating performance and a solid return on invested capital go hand in hand with sustainable development.

Holcim continues to invest in research and development. They have the Innovation and Development Center, located in Lyon (France), with satellite locations in various regions developing a comprehensive portfolio of innovators and sustainable solutions. These include different categories: inclusive business models, water management solutions, urban mining solutions (recycled aggregates), waste treatment services, energy-efficient solutions (insulating building materials), resource-efficient solutions (high recycled content, bags soluble cement), and low CO2 building materials.

Holcim operates with the belief that they can gain an advantage by developing knowledge and brand equity in the green building segment.

STUDY GOAL

The intended application of this life cycle assessment (LCA) is to comply with the procedures for creating a Type III environmental product declaration (EPD) and publish the EPD for public review on the website, http://labelingsustainability.com/ . This level of study is in accordance with EPD Product Category Rule (PCR) for Ready Mix Concrete published by NSF International (2019) and is a sub-PCR of International Standards Organization (ISO) 21930:2017 Sustainability in buildings and civil works - Core rules for EPDs of construction products and services; International Standards Organization (ISO) 14025:2006 Environmental labels and declarations, Type III environmental declarations-Principles and procedures; ISO 14044:2006 Environmental management, Life cycle assessment- Requirements and guidelines; and ISO 14040:2006 Environmental management, Life cycle assessment-Principles and framework. The performance of this study and its subsequent publishing is in alignment with the business-to-business (B2B) communication requirements for the environmental assessment of building products. The study does not intend to support comparative assertions and is intended to be disclosed to the public.

This project report was commissioned to differentiate Holcim México Operaciones S.A. de C.V. from their competition for the following reasons: generate an advantage for the organization; offer customers information to help them make informed product decisions; improve the environmental performance of Holcim México Operaciones S.A. de C.V. by continuously measuring, controlling and reducing the environmental impacts of their products; help project facilitators working on Leadership

in Energy and Environmental Design (LEED) projects achieve their credit goal; and to strengthen Holcim México Operaciones S.A. de C.V.'s license to operate in the community. The intended audience for this LCA report is Holcim México Operaciones S.A. de C.V.'s employees, their suppliers, project specifiers of their products, architects, and engineers. The EPD report is also available for policy makers, government officials interested in sustainability, academic professors, and LCA professionals. This LCA report does not include product comparisons from other facilities.

DESCRIPTION OF PRODUCT AND SCOPE

This EPD reports on 52 concrete mixes manufactured at the Holcim Mexico Operaciones S.A. de C.V. Puebla concrete facility in Puebla, México.

This LCA assumes the impacts from products manufactured in accordance with the standards outlined in this report. This LCA is a cradle-to-gate study, and therefore, stages extending beyond the plant gate are not included in this LCA. Excluded stages include transportation of the manufactured material to the construction site; on-site construction processes and components; building (infrastructure) use and maintenance; and "end-of-life" effects.

READY MIX CONCRETE DESIGN SUMMARY

The following tables provide a list of the ready mix concrete products considered in this EPD along with key performance parameters.

Mix designs: 0 to 15 MPa

Table 1: **Declared products with Mix designs: 0 to 15MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
4	24005NB0520	3.6 MPa 28d strength mortars and fillers	mortars and fillers	3.6	4.10
5	24007NB0520	3.8 MPa 28d strength mortars and fillers	mortars and fillers	3.8	3.62
6	24010NB0520	4.1 MPa 28d strength mortars and fillers	mortars and fillers	4.1	3.24
7	24015NB0520	4.6 MPa 28d strength mortars and fillers	mortars and fillers	4.6	2.94
8	24020NB0520	5.2 MPa 28d strength mortars and fillers	mortars and fillers	5.2	2.68
9	24025NB0518	5.7 MPa 28d strength mortars and fillers	mortars and fillers	5.7	2.46
10	24030NB0520	6.2 MPa 28d strength mortars and fillers	mortars and fillers	6.2	2.08
11	24035NB0520	6.7 MPa 28d strength mortars and fillers	mortars and fillers	6.7	1.85
12	77035ND2010	3.6 MPa 28d strength Ready mix concrete	Ready mix concrete	3.6	0.84
13	77036ND2010	3.7 MPa 28d strength Ready mix concrete	Ready mix concrete	3.7	0.82

14	77038ND2010	3.9 MPa 28d strength Ready mix concrete	Ready mix concrete	3.9	0.78
15	77040ND2010	4.2 MPa 28d strength Ready mix concrete	Ready mix concrete	4.2	0.75
16	68040ND4010	4.2 MPa 28d strength special concrete	special concrete	4.2	0.77
17	24040NB0520	7.1 MPa 28d strength mortars and fillers	mortars and fillers	7.1	1.67
18	77042NB4014	4.3 MPa 28d strength Ready mix concrete	Ready mix concrete	4.3	0.73
19	68042ND4010	4.3 MPa 28d strength special concrete	special concrete	4.3	0.74
20	77045NB4014	4.6 MPa 28d strength Ready mix concrete	Ready mix concrete	4.6	0.71
21	68045ND4010	4.6 MPa 28d strength special concrete	special concrete	4.6	0.71
22	77048NB4014	4.9 MPa 28d strength Ready mix concrete	Ready mix concrete	4.9	0.67
23	77050ND2006	5.2 MPa 28d strength Ready mix concrete	Ready mix concrete	5.2	0.64
24	24050NB0518	8 MPa 28d strength mortars and fillers	mortars and fillers	8.0	1.59
25	60080NB0518	10.9 MPa 28d strength mortars and fillers	mortars and fillers	10.9	1.51
26	70100NB2018	13.2 MPa 28d strength Ready mix concrete	Ready mix concrete	13.2	1.44
27	11100NB0514	13.1 MPa 28d strength mortars and fillers	mortars and fillers	13.1	1.39
28	11125ND0514	13.8 MPa 28d strength mortars and fillers	mortars and fillers	13.8	1.33

Mix designs: 15 to 20 MPa

Table 2: **Declared products with Mix designs: 15 to 20MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
29	70150NB2018	16.7 MPa 28d strength Ready mix concrete	Ready mix concrete	16.7	1.26

Mix designs: 21 to 25 MPa

Table 3: **Declared products with Mix designs: 21 to 25MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
30	76150NB2018	21.3 MPa 28d strength special concrete	special concrete	21.3	0.89

31	70175NB2014	20.3 MPa 28d strength Ready mix concrete	Ready mix concrete	20.3	1.15
32	71200NB1214	22.8 MPa 28d strength Ready mix concrete	Ready mix concrete	22.8	1.06
33	76200NB2018	22.8 MPa 28d strength special concrete	special concrete	22.8	0.74
34	70210NB2014	23.7 MPa 28d strength Ready mix concrete	Ready mix concrete	23.7	1.01

Mix designs: 26 to 30 MPa

Table 4: **Declared products with Mix designs: 26 to 30MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
35	02250NB2014	27.7 MPa 28d strength Ready mix concrete	Ready mix concrete	27.7	0.89

Mix designs: 31 to 35 MPa

Table 5: **Declared products with Mix designs: 31 to 35MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
36	60250ND2010	33.5 MPa 28d strength special concrete	special concrete	33.5	0.76
37	70280NB2014	30.6 MPa 28d strength Ready mix concrete	Ready mix concrete	30.6	0.82
38	04300NB2018	32.6 MPa 28d strength Ready mix concrete	Ready mix concrete	32.6	0.75
39	81300ND1000	32.6 MPa 28d strength special concrete	special concrete	32.6	0.25
40	70320ND2010	34.5 MPa 28d strength Ready mix concrete	Ready mix concrete	34.5	0.73

Mix designs: 36 to 40 MPa

Table 6: **Declared products with Mix designs: 36 to 40MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
3	1955ND2014	36.3 MPa 28d strength Ready mix concrete	Ready mix concrete	36.3	0.55
41	04350NB2018	37.5 MPa 28d strength Ready mix concrete	Ready mix concrete	37.5	0.65

42	56350NB1265	37.8 MPa 28d strength special concrete	special concrete	37.8	0.55
43	70360NB2014	38.5 MPa 28d strength Ready mix concrete	Ready mix concrete	38.5	0.65

Mix designs: 41 to 45 MPa

Table 7: **Declared products with Mix designs: 41 to 45MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
2	1950ND4012	42.5 MPa 28d strength Ready mix concrete	Ready mix concrete	42.5	0.50
44	13400ND2012	42.4 MPa 28d strength Ready mix concrete	Ready mix concrete	42.4	0.53

Mix designs: 46 to 50 MPa

Table 8: **Declared products with Mix designs: 46 to 50MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
1	1945NB2018	49.6 MPa 28d strength Ready mix concrete	Ready mix concrete	49.6	0.45
46	13450NB2012	47.3 MPa 28d strength Ready mix concrete	Ready mix concrete	47.3	0.49

Mix designs: 51 to 55 MPa

Table 9: **Declared products with Mix designs: 51 to 55MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
48	13500NB2012	52.2 MPa 28d strength Ready mix concrete	Ready mix concrete	52.2	0.46

Mix designs: 56 to 60 MPa

Table 10: **Declared products with Mix designs: 56 to 60MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
50	13550NB2012	57.1 MPa 28d strength Ready mix concrete	Ready mix concrete	57.1	0.42

Mix designs: >60 MPa

Table 11: **Declared products with Mix designs: >60MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
45	60400NB1265	70.6 MPa 28d strength special concrete	special concrete	70.6	0.39
47	60450NB1265	60.9 MPa 28d strength special concrete	special concrete	60.9	0.48
49	60500NB1265	79.2 MPa 28d strength special concrete	special concrete	79.2	0.34
51	60550NB1265	76.6 MPa 28d strength special concrete	special concrete	76.6	0.35
52	13600NB2012	62 MPa 28d strength Ready mix concrete	Ready mix concrete	62.0	0.40

READY MIX CONCRETE DESIGN COMPOSITION

The following figures provide mass breakdown (kg per functional unit) of the material composition of each ready mix concrete design considered. Please note that the presented breakdown has been randomly altered by +/-10%, and is therefore only an approximation; this manipulation is to ensure confidentiality.

Table 12: **Ready mix concrete composition**

Product Components	Raw Material, weight%
Cement	Proprietary
Mineral Additions (River sand and Gravel)	30-60.00
Others	0.01-5.00
Total	100.00

SYSTEM BOUNDARIES

The following figure depicts the cradle-to-gate system boundary considered in this study:

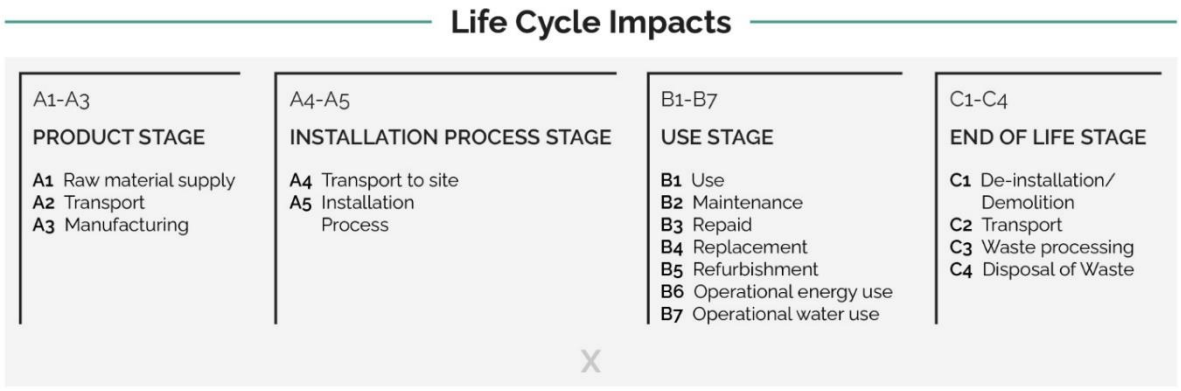

Figure 1: **General life cycle phases for consideration in a construction works system**

This is a Cradle-to-gate life cycle assessment and the following life cycle stages are included in the study:

- A1: Raw material supply (upstream processes) - Extraction, handling, and processing of the materials used in manufacturing the declared products in this LCA.
- A2: Transportation - Transportation of A1 materials from the supplier to the "gate" of the manufacturing facility (i.e. A3).
- A3: Manufacturing (core processes)- The energy and other utility inputs used to store, move, and manufacturer the declared products and to operate the facility.

As according to the PCR, the following figure illustrates the general activities and input requirements for producing ready mix concrete products and is not necessarily exhaustive.

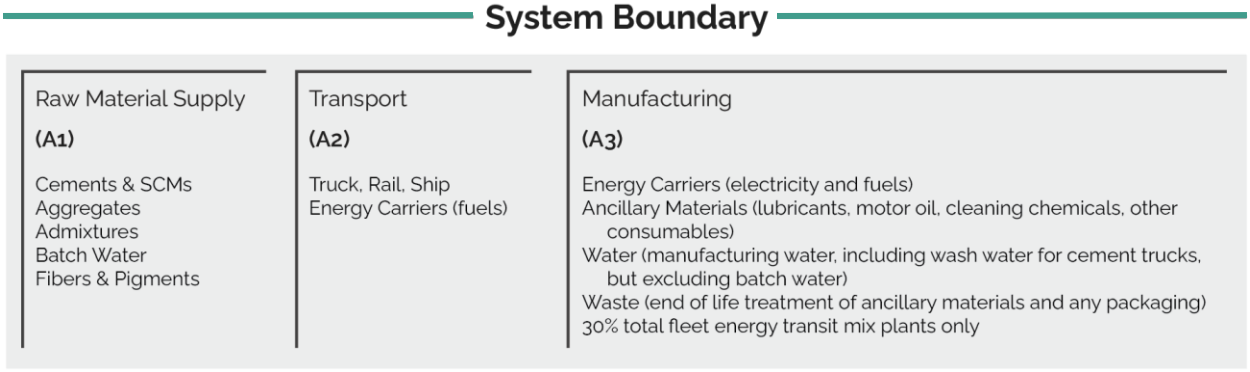

Figure 2: **General system inputs considered in the product system and categorized by modules in scope**

In addition, as according to the relevant PCR, the following requirements are excluded from this study:

- Production, manufacture and construction of A3 building/capital goods and infrastructure;
- Production and manufacture of steel production equipment, steel delivery vehicles, earth-moving equipment, and laboratory equipment;
- Personnel-related activities (travel, furniture, office supplies);
- Energy use related to company management and sales activities.

For this LCA the manufacturing plant, owned and operated by Holcim México Operaciones S.A. de C.V., is located at their Planta Puebla facility in México. All operating data is formulated using the actual data from Holcim México Operaciones S.A. de C.V.'s plant at the above location, including water, energy consumption and waste generation. All inputs for this system boundary are calculated for the plant.

This life cycle inventory was organized in a spreadsheet and was then input into an RStudio environment where pre-calculated LCIA results for relevant products/activities stemming from the ecoinvent v3.8 database and a local EPD database in combination with primary data from Holcim México Operaciones S.A. de C.V. were utilized. Explanations of the contribution of each data source to this study are outlined in the section 'Data Sources and Quality'. Further LCI details for each declared product are provided in the sections 'Detailed LCI tables' and 'Transport tables' of the detailed LCA report. A parameter uncertainty analysis was also performed where key statistical results (e.g. min/mean/max etc.) are provided in the detailed LCA report.

CUT-OFF CRITERIA

ISO 14044:2006 and the focus PCR requires the LCA model to contain a minimum of 95% of the total inflows (mass and energy) to the upstream and core modules be included in this study. The cut-off criteria were applied to all other processes unless otherwise noted above as follows. A 1% cut-off is considered for all renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process where the total of the neglected inputs does not exceed 5%.

DATA SOURCES AND DATA QUALITY ASSESSMENT

Raw material transport: A combination of actual mode/distance combinations were assumed for key bulk materials whereas ecoinvent default multi-modal market mix distances were assumed for other inputs where no original data could be provided.

Electricity: Electricity consumption values are for Holcim Mexico in calendar year 2022. These values were direct reported from Holcim records. The unit process "market for electricity, medium voltage/electricity, medium voltage/MX/kWh" was used to represent the Mexico grid electricity used by the concrete plant.

Process/space heating: No fuel is used for space heating at this plant.

Fuel required for machinery: Machinery-related fuel requirements were determined from direct Holcim information. The types of machinery used include generators, pumps to pump concrete to higher elevations, and transportation equipment used for moving materials.

Waste generation: Waste generation values are directly reported from Holcim operations for both bulk waste and hazardous waste. No High-level radioactive waste is generated on-site at this facility. Wash water values are direct reported water use from Holcim México for 2022.

Recovered energy: not applicable.

Recycled/reused material/components: The amount of returned concrete is based on Holcim primary data for the reference year, 2022.

Module A1 material losses: Due to lack of data, default loss factors of 5% were assumed. The PCR states" A3 shall include an assumption of 5% material loss unless product specific data is available and transparently reported in the project LCA report underlying the EPD;"

Direct A3 emissions accounting: Direct emissions are modeled using fuel and technology appropriate ecoinvent activities. See LCI input tables for details.

Waste transport requirements: Transportation distances are using estimated values. The waste hauler cannot guarantee the exact distances traveled due to the variation of route and actual location of disposal. Most waste disposal sites are near the plant therefore the 25 km distance is a representative estimate. Returned concrete and wash water, measured in kilograms, is based on direct Holcim reporting for the reference year 2022.

Product transport requirements: The diesel fuel used by the mixing trucks is direct primary information reported from Holcim México records for the year 2022. The concrete PCR allots 30% of the overall mixing truck total for stage A3 (manufacturing) for mixing the materials.

The following tables depict a list of assumed life cycle inventory utilized in the LCA modeling to generate the impact results across the life cycle modules in scope. An assessment of the quality of each LCI activities utilized from various sources is also provided.

Table 13: **LCI inputs assumed for module A1 (i.e. raw material supply)** ***Data Quality Assessment Key Fair=1, Good=2, Very Good =3.***

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Water	tap water production, conventional with biological treatment/tap water/RoW/kg	ecoinvent v3.8	Puebla	v3.8 in 2021	2	3	1	3	3
Limestone Gravel	limestone quarry operation/limestone, unprocessed/RoW/kg ; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	Puebla, Veracruz	v3.8 in 2021	2	3	1	3	3
Additives	market for chemical, organic/chemical, organic/GLO/kg	ecoinvent v3.8	Estado de México, Querétaro	v3.8 in 2021	2	3	1	3	3
Cement (CPC 40) - PROVEEDOR: HOLCIM Orizaba	CPC 40	Progam Operator: Labeling Sustainability- EPD ID: 565b7deb-ebd6-4cb3-9aa6-	Veracruz	25 February 2023	3	3	3	3	3

		a585381c41f3							
Cement (CPO 30R RS BRA) - PROVEEDOR: HOLCI Orizaba	CPC 30R	Progam Operator: Labeling Sustainability- EPD ID: 565b7deb-ebd6-4cb3-9aa6-a585381c41f3	Veracruz	25 February 2023	2	3	1	3	3
Natural River sand	sand quarry operation, extraction from river bed/sand/BR/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	Tlaxcala	v3.8 in 2021	2	3	1	3	3

DATA QUALITY ASSESSMENT

Data quality/variability requirements, as specified in the PCR, are applied. This section describes the achieved data quality relative to the ISO 14044:2006 requirements. Data quality is judged based on its precision (measured, calculated, or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied within a study serving as a data source) and representativeness (geographical, temporal, and technological).

Precision: Through measurement and calculation, the manufacturers collected and provided primary data on their annual production. For accuracy, the LCA practitioner and 3rd Party Verifier validated the plant gate-to-gate data.

Completeness: All relevant specific processes, including inputs (raw materials, energy, and ancillary materials) and outputs (emissions and production volume) were considered and modeled to represent the specified and declared products. The majority of relevant background materials and processes were taken from ecoinvent v3.8 LCI datasets where relatively recent region-specific electricity inputs were utilized. The most relevant EPDs requiring key A1 inputs were also utilized where readily available.

Consistency: To ensure consistency, the same modeling structure across the respective product systems was utilized for all inputs, which consisted of raw material inputs and ancillary material, energy flows, water resource inputs, product, and co-products outputs, returned and recovered Ready Mix Concrete materials, emissions to air, water and soil, and waste recycling and treatment. The same background LCI datasets from the ecoinvent v3.8 database were used across all product systems. Crosschecks concerning the plausibility of mass and energy flows were continuously conducted. The LCA team conducted mass and energy balances at the plant and selected process level to maintain a high level of consistency.

Reproducibility: Internal reproducibility is possible since the data and the models are stored and available in a machine readable project file for all foreground and background processes, and in Labeling Sustainability's proprietary Ready Mix Concrete LCA calculator* for all production facility

and product-specific calculations. A considerable level of transparency is provided throughout the detailed LCA report as the specifications and material quantity make-up for the declared products are presented and key primary and secondary LCI data sources are summarized. The provision of more detailed publicly accessible data to allow full external reproducibility was not possible due to reasons of confidentiality.

*Labeling Sustainability has developed a proprietary tool that allows the calculation of PCR-compliant LCA results for Ready Mix Concrete product designs. The tool auto-calculates results by scaling base-unit technosphere inputs (i.e. 1 kg sand, 1 kWh electricity, etc.) to replicate the reference flow conversions that take place in any typical LCA software like openLCA or SimaPro. The tool was tested against several LCAs performed in openLCA and the tool generated identical results to those realized in openLCA across every impact category and inventory metric (where comparisons could be readily made).

Representativeness: The representativeness of the data is summarized as follows.

- Time related coverage of the manufacturing processes' primary collected data from 2022-01-01 to 2022-12-31.
- Upstream (background) LCI data was either the PCR specified default (if applicable) or more appropriate LCI datasets as found in the country-adjusted ecoinvent v3.8 database.
- Geographical coverage for inputs required by the A3 facility(ies) is representative of its region of focus; other upstream and background processes are based on US, North American, or global average data and adjusted to regional electricity mixes when relevant.
- Technological coverage is typical or average and specific to the participating facilities for all primary data.

ENVIRONMENTAL INDICATORS AND INVENTORY METRICS

Per the PCR, this EPD supports the life cycle impact assessment indicators and inventory metrics as listed in the tables below. As specified in the PCR, the most recent US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), impact categories were utilized as they provide a North American context for the mandatory category indicators to be included in the EPD. Additionally, the PCR requires a set of inventory metrics to be reported with the LCIA indicators (see tables below).

It should be noted that emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in any of the following categories.

LIMITATIONS

This EPD is a declaration of potential environmental impact and does not support or provide definitive comparisons of the environmental performance of specific products. Only EPDs prepared from cradle-to-grave life cycle results and based on the same function and reference service life and quantified by the same functional unit can be used to assist purchasers and users in making informed comparisons between products.

LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. Further, LCA offers a wide array of environmental impact indicators, and this EPD reports a collection of those, as specified by the PCR.

In addition to the impact results, this EPD provides several metrics related to resource consumption and waste generation. While these data may be informational in other ways, they do not provide a measure of impact on the environment.

TOTAL IMPACT SUMMARY

The following table reports the total LCA results for each product produced at the given ready mix concrete facility on a per 1m3 of concrete basis.

Mix designs: 0 to 15 MPa

Table 14: **Total life cycle (across modules in scope) impact results for Mix designs: 0 to 15MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	12	0.0204	100	1.01e-05	0.166	0.000231	769
Maximum	37.5	0.0631	408	3.38e-05	0.432	0.000836	2630
Mean	25.3	0.0426	261	2.24e-05	0.306	0.000547	1750
Median	23.8	0.0396	249	2.09e-05	0.289	0.000499	1650
24005NB0520	12	0.0204	100	1.01e-05	0.166	0.000231	769
24007NB0520	12.7	0.0215	110	1.07e-05	0.174	0.000247	822
24010NB0520	13.4	0.0227	119	1.14e-05	0.181	0.000263	874
24015NB0520	14.1	0.0238	129	1.2e-05	0.188	0.000279	926
24020NB0520	14.8	0.025	139	1.27e-05	0.195	0.000295	979
24025NB0518	15.5	0.026	147	1.33e-05	0.202	0.000308	1020
24030NB0520	17.1	0.0287	172	1.49e-05	0.218	0.000346	1150
24035NB0520	18.4	0.0307	190	1.6e-05	0.23	0.000375	1240
77035ND2010	31.9	0.0539	329	2.85e-05	0.378	0.000706	2210
77036ND2010	32.3	0.0546	334	2.89e-05	0.382	0.000716	2240
77038ND2010	33.1	0.0559	346	2.96e-05	0.39	0.000734	2300
77040ND2010	33.9	0.0572	357	3.04e-05	0.397	0.000751	2360
68040ND4010	34.4	0.0581	354	3.06e-05	0.404	0.000781	2430
24040NB0520	19.7	0.0329	209	1.73e-05	0.243	0.000405	1350
77042NB4014	34.7	0.0586	368	3.12e-05	0.406	0.000773	2430
68042ND4010	35.1	0.0593	365	3.13e-05	0.411	0.000798	2480
77045NB4014	35.7	0.0602	383	3.21e-05	0.415	0.000796	2500
68045ND4010	36.2	0.061	381	3.23e-05	0.421	0.000822	2560
77048NB4014	37.3	0.0627	404	3.36e-05	0.43	0.000831	2620
77050ND2006	37.5	0.0631	408	3.38e-05	0.432	0.000836	2630
24050NB0518	20.3	0.0339	216	1.78e-05	0.25	0.000418	1390
60080NB0518	21.1	0.0352	227	1.86e-05	0.258	0.000434	1440

70100NB2018	24.5	0.0418	229	2.16e-05	0.305	0.000535	1660
11100NB0514	23.2	0.0386	249	2.03e-05	0.283	0.000484	1600
11125ND0514	23.8	0.0396	258	2.09e-05	0.289	0.000499	1650

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWB	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	843	16.3	826	20.8	0.000258	5.7	36.1	0.00131	0.252	3.41e-05	0.000431	0.0747
Maximum	2890	51.5	2840	70.9	0.000824	12.7	144	0.00353	0.336	3.41e-05	0.000431	0.0747
Mean	1910	35.2	1880	47.1	0.000549	9.28	92	0.00245	0.297	3.41e-05	0.000431	0.0747
Median	1810	36.4	1780	44.4	0.000489	11.5	84.9	0.00208	0.329	3.41e-05	0.000431	0.0747
24005NB05 20	843	16.3	826	20.8	0.000258	11.8	36.1	0.00131	0.336	3.41e-05	0.000431	0.0747
24007NB05 20	899	17.7	885	22.3	0.000271	11.8	39.2	0.00135	0.335	3.41e-05	0.000431	0.0747
24010NB05 20	957	18.9	940	23.5	0.000282	11.8	42.4	0.0014	0.334	3.41e-05	0.000431	0.0747
24015NB05 20	1010	20.2	994	25	0.000299	11.9	45.5	0.00144	0.333	3.41e-05	0.000431	0.0747
24020NB05 20	1080	21.5	1050	26.3	0.00031	11.9	48.6	0.00149	0.332	3.41e-05	0.000431	0.0747
24025NB05 18	1120	22.6	1100	27.6	0.000318	12	51.5	0.00153	0.329	3.41e-05	0.000431	0.0747
24030NB05 20	1260	25.7	1230	30.9	0.000349	11.7	59.3	0.00162	0.334	3.41e-05	0.000431	0.0747
24035NB05 20	1370	28.2	1340	33.5	0.000378	11.6	65.1	0.00169	0.335	3.41e-05	0.000431	0.0747
77035ND20 10	2430	41.8	2380	59.7	0.00071	6.97	118	0.00318	0.255	3.41e-05	0.000431	0.0747
77036ND20 10	2450	42.5	2410	60.7	0.000717	6.9	120	0.0032	0.254	3.41e-05	0.000431	0.0747
77038ND20 10	2520	43.7	2480	62	0.000731	6.73	124	0.00325	0.253	3.41e-05	0.000431	0.0747
77040ND20 10	2590	45.2	2530	63.9	0.000745	6.57	127	0.0033	0.252	3.41e-05	0.000431	0.0747
68040ND40 10	2650	45.3	2610	65.8	0.000784	6.05	127	0.00339	0.252	3.41e-05	0.000431	0.0747
24040NB05 20	1480	30.5	1450	36.1	4e-04	11.5	71.2	0.00177	0.336	3.41e-05	0.000431	0.0747
77042NB40 14	2660	46.5	2620	65.7	0.000761	6.21	131	0.00337	0.255	3.41e-05	0.000431	0.0747
68042ND40 10	2720	46.7	2670	67.3	0.000804	5.89	130	0.00343	0.252	3.41e-05	0.000431	0.0747

77045NB4014	2740	47.9	2700	67.5	0.000785	5.99	136	0.00342	0.256	3.41e-05	0.000431	0.0747
68045ND4010	2810	48.9	2760	69.4	0.000824	5.7	135	0.00349	0.255	3.41e-05	0.000431	0.0747
77048NB4014	2870	51.1	2820	70.5	0.000812	5.96	143	0.00352	0.259	3.41e-05	0.000431	0.0747
77050ND2006	2890	51.5	2840	70.9	0.000811	5.86	144	0.00353	0.252	3.41e-05	0.000431	0.0747
24050NB0518	1520	31.2	1490	37.1	0.000413	11.7	73.5	0.00182	0.333	3.41e-05	0.000431	0.0747
60080NB0518	1580	32.7	1550	38.6	0.000422	11.9	77	0.00187	0.334	3.41e-05	0.000431	0.0747
70100NB2018	1820	29.5	1780	45.1	0.000568	8.22	84.9	0.00266	0.287	3.41e-05	0.000431	0.0747
11100NB0514	1770	36.4	1730	43	0.000473	12.7	84.2	0.00204	0.336	3.41e-05	0.000431	0.0747
11125ND0514	1810	37.7	1780	44.4	0.000489	12.6	87.2	0.00208	0.336	3.41e-05	0.000431	0.0747

Mix designs: 15 to 20 MPa

Table 15: **Total life cycle (across modules in scope) impact results for Mix designs: 15 to 20MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	**AP**	**EP**	**GWP**	**ODP**	**PCOP**	**ADPe**	**ADPf**
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
70150NB2018	26	0.0443	249	2.3e-05	0.32	0.00057	1780

b) Inventory Metrics:

Indicator/LCI Metric	**TPE**	**RE**	**NRE**	**NRR**	**RR**	**WDP**	**LFW**	**LFHW**	**CBWC**	**CWWC**	**CHW**	**CNHW**
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m3**	**m3**	**kg waste**	**kg waste**	**m3**	**m3**	**kg**	**kg**
70150NB2018	1940	31.8	1910	48.2	0.000593	7.9	91.7	0.00277	0.276	3.41e-05	0.000431	0.0747

Mix designs: 21 to 25 MPa

Table 16: **Total life cycle (across modules in scope) impact results for Mix designs: 21 to 25MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	26.9	0.0458	259	2.38e-05	0.33	0.000591	1840
Maximum	34.5	0.0573	406	3.12e-05	0.386	0.000759	2450
Mean	29.7	0.05	317	2.66e-05	0.349	0.000653	2070
Median	28.7	0.0487	285	2.55e-05	0.342	0.000631	1970
76150NB2018	30.3	0.0504	352	2.74e-05	0.342	0.000664	2140
70175NB2014	26.9	0.0458	259	2.38e-05	0.33	0.000591	1840
71200NB1214	28.3	0.048	285	2.52e-05	0.342	0.000621	1950
76200NB2018	34.5	0.0573	406	3.12e-05	0.386	0.000759	2450
70210NB2014	28.7	0.0487	284	2.55e-05	0.347	0.000631	1970

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2010	33	1980	49.9	0.000611	5.87	95.2	0.00257	0.258	3.41e-05	0.000431	0.0747
Maximum	2680	53	2640	65.7	7e-04	7.83	138	0.00297	0.315	3.41e-05	0.000431	0.0747
Mean	2270	40.9	2230	55.8	0.000643	7	112	0.00283	0.283	3.41e-05	0.000431	0.0747
Median	2150	36.5	2110	53.3	0.000629	7.55	103	0.00288	0.275	3.41e-05	0.000431	0.0747
76150NB2018	2360	46.4	2320	57.5	0.000629	6.01	120	0.00257	0.315	3.41e-05	0.000431	0.0747
70175NB2014	2010	33	1980	49.9	0.000611	7.83	95.2	0.00286	0.262	3.41e-05	0.000431	0.0747
71200NB1214	2140	36.5	2090	52.6	0.000627	7.76	103	0.00288	0.275	3.41e-05	0.000431	0.0747
76200NB2018	2680	53	2640	65.7	7e-04	5.87	138	0.00289	0.304	3.41e-05	0.000431	0.0747
70210NB2014	2150	35.8	2110	53.3	0.000647	7.55	103	0.00297	0.258	3.41e-05	0.000431	0.0747

Mix designs: 26 to 30 MPa

Table 17: **Total life cycle (across modules in scope) impact results for Mix designs: 26 to 30MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
02250NB2014	31.3	0.0529	322	2.79e-05	0.372	0.000692	2170

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
02250NB2014	2380	41.2	2330	58.7	0.000695	7.11	116	0.00311	0.265	3.41e-05	0.000431	0.0747

Mix designs: 31 to 35 MPa

Table 18: **Total life cycle (across modules in scope) impact results for Mix designs: 31 to 35MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	32.3	0.0546	336	2.89e-05	0.382	0.000715	2240
Maximum	41.1	0.0697	444	3.76e-05	0.467	0.000924	2860
Mean	35	0.0592	370	3.15e-05	0.408	0.000779	2440
Median	34.4	0.0579	363	3.08e-05	0.402	0.000762	2400
60250ND2010	32.7	0.0554	339	2.92e-05	0.387	0.000728	2280
70280NB2014	32.3	0.0546	336	2.89e-05	0.382	0.000715	2240
04300NB2018	34.4	0.0579	367	3.08e-05	0.402	0.000762	2400
81300ND1000	41.1	0.0697	444	3.76e-05	0.467	0.000924	2860
70320ND2010	34.5	0.0583	363	3.09e-05	0.404	0.000767	2410

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2460	42.5	2410	60.5	0.000715	0.455	120	0.00319	0.105	3.41e-05	0.000431	0.0747
Maximum	3110	51.3	3080	77.2	0.000891	7	161	0.00409	0.261	3.41e-05	0.000431	0.0747
Mean	2670	45.9	2630	65.8	0.000773	5.54	132	0.00343	0.222	3.41e-05	0.000431	0.0747
Median	2630	45.8	2590	64.9	0.000763	6.86	130	0.00328	0.25	3.41e-05	0.000431	0.0747
60250ND2010	2490	43.2	2450	61.5	0.000734	6.99	121	0.00324	0.24	3.41e-05	0.000431	0.0747
70280NB2014	2460	42.5	2410	60.5	0.000715	7	120	0.00319	0.255	3.41e-05	0.000431	0.0747
04300NB2018	2630	46.7	2590	64.9	0.000763	6.86	130	0.00328	0.261	3.41e-05	0.000431	0.0747
81300ND1000	3110	51.3	3080	77.2	0.000891	0.455	161	0.00409	0.105	3.41e-05	0.000431	0.0747
70320ND2010	2640	45.8	2600	65.1	0.000763	6.37	130	0.00337	0.25	3.41e-05	0.000431	0.0747

Mix designs: 36 to 40 MPa

Table 19: **Total life cycle (across modules in scope) impact results for Mix designs: 36 to 40MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	35.1	0.0592	411	3.22e-05	0.389	0.00054	2500
Maximum	40	0.0667	449	3.58e-05	0.458	0.000887	2840
Mean	37.6	0.0632	426	3.4e-05	0.429	0.000776	2660
Median	37.8	0.0634	422	3.4e-05	0.434	0.000839	2650
1955ND2014	35.1	0.0592	426	3.22e-05	0.389	0.00054	2500
04350NB2018	38	0.0637	419	3.42e-05	0.436	0.000845	2670
56350NB1265	40	0.0667	449	3.58e-05	0.458	0.000887	2840
70360NB2014	37.5	0.063	411	3.38e-05	0.432	0.000833	2630

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2730	42.4	2680	65.7	0.000604	5.17	32.1	0.00282	0.203	3.41e-05	0.000431	0.0747
Maximum	3130	59.2	3060	76.3	0.000853	8.73	154	0.00351	0.262	3.41e-05	0.000431	0.0747
Mean	2920	52	2860	71.3	0.000774	6.67	120	0.00332	0.242	3.41e-05	0.000431	0.0747
Median	2900	53.2	2850	71.6	0.00082	6.38	146	0.00348	0.25	3.41e-05	0.000431	0.0747
1955ND2014	2730	42.4	2680	65.7	0.000604	5.17	32.1	0.00282	0.203	3.41e-05	0.000431	0.0747
04350NB2018	2920	53.8	2870	71.9	0.000821	6.43	147	0.00349	0.262	3.41e-05	0.000431	0.0747
56350NB1265	3130	59.2	3060	76.3	0.000853	8.73	154	0.00351	0.242	3.41e-05	0.000431	0.0747
70360NB2014	2880	52.6	2830	71.2	0.000819	6.34	145	0.00348	0.259	3.41e-05	0.000431	0.0747

Mix designs: 41 to 45 MPa

Table 20: **Total life cycle (across modules in scope) impact results for Mix designs: 41 to 45MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	36.8	0.0622	434	3.34e-05	0.409	0.000604	2670
Maximum	43.3	0.0723	481	3.86e-05	0.49	0.000995	3140
Mean	40	0.0672	458	3.6e-05	0.45	8e-04	2900
Median	40	0.0672	458	3.6e-05	0.45	8e-04	2900
1950ND4012	36.8	0.0622	434	3.34e-05	0.409	0.000604	2670
13400ND2012	43.3	0.0723	481	3.86e-05	0.49	0.000995	3140

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2930	44.5	2880	70.5	0.000681	5.18	34.6	0.00303	0.184	3.41e-05	0.000431	0.0747
Maximum	3440	63.7	3390	84.7	0.000979	6.07	166	0.00382	0.249	3.41e-05	0.000431	0.0747
Mean	3180	54.1	3140	77.6	0.00083	5.62	100	0.00342	0.216	3.41e-05	0.000431	0.0747
Median	3180	54.1	3140	77.6	0.00083	5.62	100	0.00342	0.216	3.41e-05	0.000431	0.0747
1950ND4012	2930	44.5	2880	70.5	0.000681	5.18	34.6	0.00303	0.184	3.41e-05	0.000431	0.0747
13400ND2012	3440	63.7	3390	84.7	0.000979	6.07	166	0.00382	0.249	3.41e-05	0.000431	0.0747

Mix designs: 46 to 50 MPa

Table 21: **Total life cycle (across modules in scope) impact results for Mix designs: 46 to 50MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	42.1	0.0706	523	3.86e-05	0.453	0.000659	3100
Maximum	46.2	0.0769	532	4.13e-05	0.518	0.00106	3360
Mean	44.2	0.0738	528	4e-05	0.486	0.00086	3230
Median	44.2	0.0738	528	4e-05	0.486	0.00086	3230
1945NB2018	42.1	0.0706	532	3.86e-05	0.453	0.000659	3100
13450NB2012	46.2	0.0769	523	4.13e-05	0.518	0.00106	3360

b) Inventory Metrics:

Indicator/ LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	3390	57.4	3340	81.2	0.000725	6	34.4	0.00311	0.21	3.41e-05	0.000431	0.0747
Maximum	3700	69.1	3620	90.3	0.00104	6.19	179	0.00396	0.252	3.41e-05	0.000431	0.0747
Mean	3540	63.2	3480	85.8	0.000882	6.1	107	0.00354	0.231	3.41e-05	0.000431	0.0747
Median	3540	63.2	3480	85.8	0.000882	6.1	107	0.00354	0.231	3.41e-05	0.000431	0.0747
1945NB2018	3390	57.4	3340	81.2	0.000725	6.19	34.4	0.00311	0.21	3.41e-05	0.000431	0.0747
13450NB2012	3700	69.1	3620	90.3	0.00104	6	179	0.00396	0.252	3.41e-05	0.000431	0.0747

Mix designs: 51 to 55 MPa

Table 22: **Total life cycle (across modules in scope) impact results for Mix designs: 51 to 55MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
13500NB2012	48	0.0799	548	4.29e-05	0.535	0.0011	3500

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
13500NB2012	3860	72.9	3780	94.1	0.00107	5.7	187	0.00408	0.25	3.41e-05	0.000431	0.0747

Mix designs: 56 to 60 MPa

Table 23: **Total life cycle (across modules in scope) impact results for Mix designs: 56 to 60MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
13550NB2012	51	0.0848	591	4.57e-05	0.565	0.00118	3740

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
13550NB2012	4090	78.1	4030	100	0.00113	5.34	201	0.00425	0.25	3.41e-05	0.000431	0.0747

Mix designs: >60 MPa

Table 24: **Total life cycle (across modules in scope) impact results for Mix designs: >60MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	44.4	0.074	508	3.98e-05	0.501	0.001	3190
Maximum	56.5	0.0935	686	5.12e-05	0.617	0.00127	4090
Mean	52.2	0.0865	619	4.71e-05	0.575	0.00118	3770
Median	53.8	0.0893	629	4.82e-05	0.591	0.00123	3950
60400NB1265	51	0.0845	606	4.61e-05	0.564	0.00114	3660
60450NB1265	44.4	0.074	508	3.98e-05	0.501	0.001	3190
60500NB1265	56.5	0.0935	686	5.12e-05	0.617	0.00127	4090
60550NB1265	55.1	0.0913	667	5e-05	0.602	0.00123	3980
13600NB2012	53.8	0.0893	629	4.82e-05	0.591	0.00124	3950

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	3510	67.3	3450	85.8	0.000954	5.01	173	0.00379	0.24	3.41e-05	0.000431	0.0747
Maximum	4500	89.8	4430	110	0.00119	7.75	230	0.00447	0.251	3.41e-05	0.000431	0.0747
Mean	4160	81.3	4080	101	0.0011	6.49	209	0.00425	0.243	3.41e-05	0.000431	0.0747
Median	4350	83.4	4250	106	0.00114	6.51	213	0.004	0.24	3.41e-05	0.000431	0.0747
60400NB1265	4050	79.1	3950	98.3	0.00106	7.2	205	0.00416	0.24	3.41e-05	0.000431	0.0747
60450NB1265	3510	67.3	3450	85.8	0.000954	7.75	173	0.00379	0.243	3.41e-05	0.000431	0.0747
60500NB1265	4500	89.8	4430	110	0.00117	6.51	230	0.00447	0.24	3.41e-05	0.000431	0.0747
60550NB1265	4380	86.8	4300	107	0.00114	5.99	225	0.004	0.24	3.41e-05	0.000431	0.0747
13600NB2012	4350	83.4	4250	106	0.00119	5.01	213	0.00441	0.251	3.41e-05	0.000431	0.0747

ADDITIONAL ENVIRONMENTAL INFO

No regulated substances of very high concern are utilized on site.

REFERENCES

ASTM Standards:

- ASTM A36/A36M Standard Specification for Carbon Structural Steel
- ASTM A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
- ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- ASTM A184 Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
- ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
- ASTM A416/A416M Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

- ASTM A555/A555M Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods
- ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- ASTM A706/A706M Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
- ASTM A767/A767M Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
- ASTM A775/A775M Standard Specification for Epoxy-Coated Steel Reinforcing Bars
- ASTM A820/A820M Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
- ASTM A884/A884M Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
- ASTM A934/A934M Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
- ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- ASTM C33/C33M Standard Specification for Concrete Aggregates
- ASTM C94 Standard Specification for Ready-Mixed Concrete
- ASTM C150/C150M Standard Specification for Portland Cement
- ASTM C260/C260M Standard Specification for Air-Entraining Admixtures for Concrete
- ASTM C595 Standard Specification for Blended Hydraulic Cements
- ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- ASTM C979/C979M Standard Specification for Pigments for Integrally Colored Concrete
- ASTM C989/C989M Standard Specification for Slag Cement for Use in Concrete and Mortars
- ASTM C1017/C1017M Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
- ASTM C1116/C1116M Standard Specification for Fiber-Reinforced Concrete
- ASTM C1157/C1157M Standard Performance Specification for Hydraulic Cement
- ASTM C1240 Standard Specification for Silica Fume Used in Cementitious Mixtures
- ASTM C1602/C1602M Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
- ASTM G109 Standard Test Method for Determining Effects of Chemical Admixtures on Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments
- ASTM C330/C330M Standard Specification for Lightweight Aggregates for Structural Concrete
- ASTM C494/C494M Standard Specification for Chemical Admixtures for Concrete

CSA Standards:

- CAN/CGSB-1.40 Anticorrosive Structural Steel Alkyd Primer
- CAN/CSA G30.18 Carbon steel bars for concrete reinforcement
- CAN/CSA A3000 Cementitious Materials Compendium
- CAN/CSA G40.20/G40.21 General requirements for rolled or welded structural quality steel / Structural quality steel
- CAN/CSA A23.1/A23.2 Concrete Materials and Methods of Concrete Construction/Test methods and Standard Practices for Concrete
- CAN/CSA A23.4 Precast concrete - Materials and construction
- CSA S806 Design and construction of building structures with fiber-reinforced polymers

ISO Standards:

- ISO 6707-1: 2014 Buildings and Civil Engineering Works - Vocabulary - Part 1: General Terms
- ISO 14021:1999 Environmental Labels and Declarations - Self-declared Environmental Claims (Type II Environmental Labeling)
- ISO 14025:2006 Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures
- ISO 14040:2006 Environmental Management - Life Cycle Assessment - Principles and Framework
- ISO 14044:2006 Environmental Management - Life Cycle Assessment - Requirements and Guidelines
- ISO 14067:2018 Greenhouse Gases - Carbon Footprint of Products - Requirements and Guidelines for Quantification
- ISO 14050:2009 Environmental Management - Vocabulary
- ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products

EN Standards:

- EN 16757 Sustainability of construction works - Environmental product declarations - Product Category Rules for concrete and concrete elements
- EN 15804 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

Other References:

- US EPA Waste Reduction Model (WARM), Fly Ash Chapter: http://epa.gov/climatechange/wycd/waste/downloads/fly-ash-chapter10-28-10.pdf
- American Concrete Institute (ACI) 211: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

- ACI 318-14 Building Code Requirements for Structural Concrete and Commentary. American Concrete Institute. Farmington Hills, MI, USA available at https://www.concrete.org/store/
- Mather, B & Ozyildirim, C. (2002). SP-1(02) : Concrete Primer. American Concrete Institute: SP0102. American Concrete Institute. Farmington Hills, MI, USA available at https://www.concrete.org/store/
- NSF International (February 2019). Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) of Concrete v1.2.
- Product Category Rules for Preparing an Environmental Product Declaration for Precast Concrete (UN CPC 37550), ASTM International, March 2015. https://www.astm.org/CERTIFICATION/DOCS/266.PCR_for_Precast_Concrete.pdf
- USGBC LEED v4 for Building Design and Construction, 11 Jan 2019 available at https://www.usgbc.org/resources/pcr-committee-process-resources-part-b
- USGBC PCR Committee Process & Resources: Part B, USGBC, 7 July 2017 available at https://www.usgbc.org/resources/pcr-committee-process-resources-part-b.