Environmental Product Declaration

Environmental Product Declaration for various ready mix concrete products produced by Holcim México Operaciones S.A. de C.V. at their Xochimilco facility in Tlalpan, Ciudad de 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:	29 July 2023
Period of Validity:	5 years; valid until 29 July 2028
EPD Number:	9b7870cf-f8e1-464f-9000-45954ab9dc20

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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 CO_2 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 54 concrete mixes manufactured at the Holcim Mexico Operaciones S.A. de C.V. Xochimilco concrete facility in Ciudad de Mexico, 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
1	60.45NB1218	0.04 MPa 28d strength special concrete	Special concrete	0.04	0.40
2	24005NB0518	0.49 MPa 28d strength mortars and fillers	Mortars and fillers	0.49	4.29
3	24007NB0518	0.69 MPa 28d strength mortars and fillers	Mortars and fillers	0.69	4.29
4	24010NB0520	0.98 MPa 28d strength mortars and fillers	Mortars and fillers	0.98	3.73
5	24015NB0518	1.47 MPa 28d strength mortars and fillers	Mortars and fillers	1.47	3.10
6	24020NB0520	1.96 MPa 28d strength mortars and fillers	Mortars and fillers	1.96	2.78
7	68025NB0518	2.45 MPa 28d strength special concrete	Special concrete	2.45	2.75
8	24025NB0520	2.45 MPa 28d strength mortars and fillers	Mortars and fillers	2.45	2.52
9	24030NB0518	2.94 MPa 28d strength mortars and fillers	Mortars and fillers	2.94	2.31
10	77035ND4014	3.43 MPa 28d strength Ready mix concrete	Ready mix concrete	3.43	0.81

11	68035NB0518	3.43 MPa 28d strength special concrete	Special concrete	3.43	2.32
12	24035NB0518	3.43 MPa 28d strength mortars and fillers	Mortars and fillers	3.43	2.12
13	77036ND2010	3.53 MPa 28d strength Ready mix concrete	Ready mix concrete	3.53	0.80
14	77038ND2010	3.73 MPa 28d strength Ready mix concrete	Ready mix concrete	3.73	0.76
15	77040ND2010	3.93 MPa 28d strength Ready mix concrete	Ready mix concrete	3.93	0.72
16	68040ND4014	3.93 MPa 28d strength special concrete	Special concrete	3.93	0.77
17	24040NB0520	3.93 MPa 28d strength mortars and fillers	Mortars and fillers	3.93	2.04
18	77042ND4014	4.12 MPa 28d strength Ready mix concrete	Ready mix concrete	4.12	0.65
19	77045ND2010	4.42 MPa 28d strength Ready mix concrete	Ready mix concrete	4.42	0.65
20	77048ND2010	4.71 MPa 28d strength Ready mix concrete	Ready mix concrete	4.71	0.63
21	77050ND2010	4.91 MPa 28d strength Ready mix concrete	Ready mix concrete	4.91	0.61
22	76050ND1218	4.91 MPa 28d strength special concrete	Special concrete	4.91	1.07
23	24050NB0520	4.91 MPa 28d strength mortars and fillers	Mortars and fillers	4.91	1.88
24	24075NB0518	7.36 MPa 28d strength mortars and fillers	Mortars and fillers	7.36	1.86
25	70100ND2010	9.81 MPa 28d strength Ready mix concrete	Ready mix concrete	9.81	1.20
26	76100ND1218	9.81 MPa 28d strength special concrete	Special concrete	9.81	0.95
27	73100NB0514	9.81 MPa 28d strength mortars and fillers	Mortars and fillers	9.81	1.50
28	71150ND1210	14.72 MPa 28d strength Ready mix concrete	Ready mix concrete	14.72	1.07
29	40150NB1214	14.72 MPa 28d strength special concrete	Special concrete	14.72	0.97
30	73150NB0514	14.72 MPa 28d strength mortars and fillers	Mortars and fillers	14.72	1.18

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
31	71175ND1214	17.17 MPa 28d strength Ready mix concrete	Ready mix concrete	17.17	0.98
32	71200ND1210	19.63 MPa 28d strength Ready mix concrete	Ready mix concrete	19.63	0.91

33	27200NB1200	19.63 MPa 28d strength special concrete ,dry mix only	Special concrete	19.63	0.00
34	73200NB0518	19.63 MPa 28d strength mortars and fillers	Mortars and fillers	19.63	0.98

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
35	71210ND1214	20.61 MPa 28d strength Ready mix concrete	Ready mix concrete	20.61	0.88
36	04250ND2012	24.53 MPa 28d strength Ready mix concrete	Ready mix concrete	24.53	0.78
37	68250NB1218	24.53 MPa 28d strength special concrete	Special concrete	24.53	0.80
38	73250NB0514	24.53 MPa 28d strength mortars and fillers	Mortars and fillers	24.53	0.85

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
39	70280NB2014	27.48 MPa 28d strength Ready mix concrete	Ready mix concrete	27.48	0.74
40	02300NB2012	29.44 MPa 28d strength Ready mix concrete	Ready mix concrete	29.44	0.70
41	40300NB1214	29.44 MPa 28d strength special concrete	Special concrete	29.44	0.69
42	73300NB0518	29.44 MPa 28d strength mortars and fillers	Mortars and fillers	29.44	0.76

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
43	70320ND2010	31.4 MPa 28d strength Ready mix concrete	Ready mix concrete	31.40	0.65
44	01350ND2010	34.35 MPa 28d strength Ready mix concrete	Ready mix concrete	34.35	0.57

45	60350NB2014	34.35 MPa 28d strength special concrete	Special concrete	34.35	0.54
46	73350NB0514	34.35 MPa 28d strength mortars and fillers	Mortars and fillers	34.35	0.68

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
47	70360NB2014	35.33 MPa 28d strength Ready mix concrete	Ready mix concrete	35.33	0.59
48	13400ND2010	39.25 MPa 28d strength Ready mix concrete	Ready mix concrete	39.25	0.41

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
49	13450ND1210	44.16 MPa 28d strength Ready mix concrete	Ready mix concrete	44.16	0.38

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
50	13500ND2012	49.07 MPa 28d strength Ready mix concrete	Ready mix concrete	49.07	0.36

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
51	13550ND1210	53.97 MPa 28d strength Ready mix concrete	Ready mix concrete	53.97	0.32
52	56550NB1275	53.97 MPa 28d strength special concrete	Special concrete	53.97	0.32

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
53	13600ND2012	58.88 MPa 28d strength Ready mix concrete	Ready mix concrete	58.88	0.29

Mix designs: >60 MPa

Table 11: **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
54	60700NB2024	68.69 MPa 28d strength special concrete	Special concrete	68.69	0.31

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: **Design composition**

Product Components	Raw Material, weight%
Cement	Proprietary
Aggregates	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:

Life Cycle Impacts

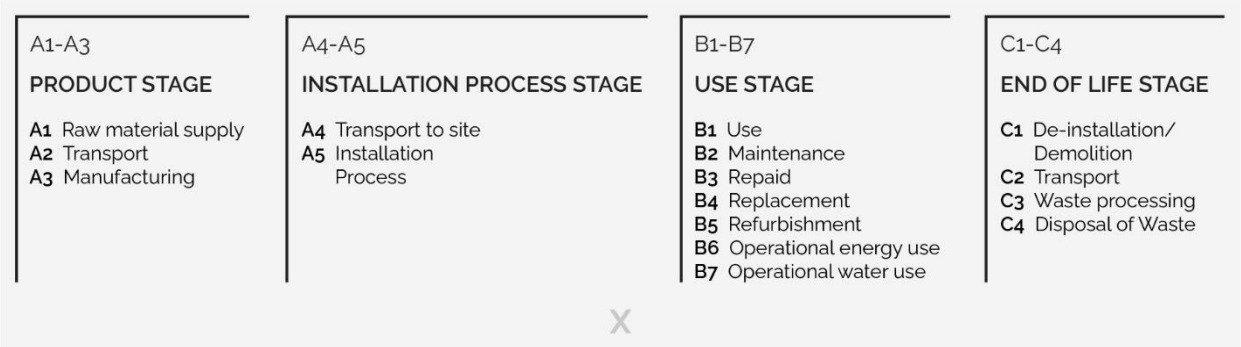

Figure 1: **General life cycle phases for consideration in a construction works system**

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.

System Boundary

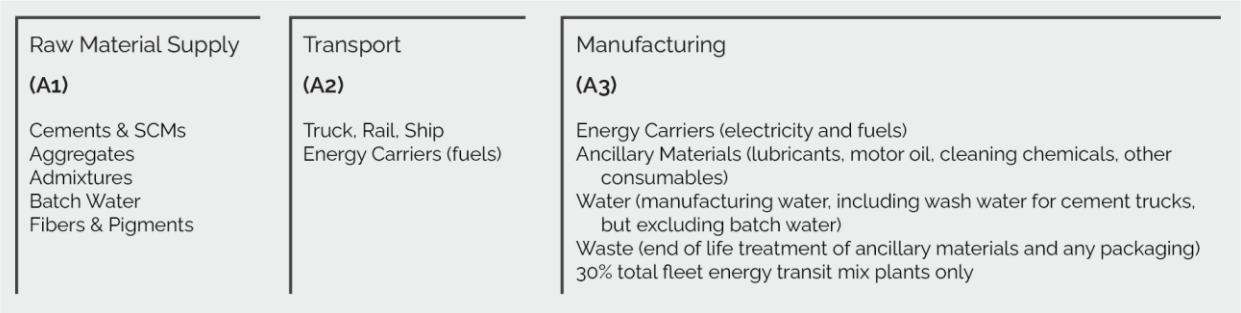

Figure 2: **General system inputs considered in the product system and categorized by modules in scope**

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 Xochilmilco 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
Andesite sand	basalt quarry operation/basalt/RoW/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	Estado de México	v3.8 in 2021	2	3	1	3	3
Water	tap water production, conventional with biological treatment/tap water/RoW/kg	ecoinvent v3.8	Estado de Mexico	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	Estado de Mexico	v3.8 in 2021	2	3	1	3	3
Additives	market for chemical, organic/chemical, organic/GLO/kg	ecoinvent v3.8	Estado de Mexico	v3.8 in 2021	2	3	1	3	3

Cement (CPC 40) Apaxco	CPC 40	Progam Operator: Labeling Sustainability- EPD ID: e38f688d-1fa5-41b0-a9b1-e5b1422ea654	Estado de México	very good, 3rd party verfied facility - specific EPD dataset	3	NA	3	3	3
Cement (CPO 30R R) PROVEEDOR: HOLCI Orizaba	CPC 30R	Progam Operator: Labeling Sustainability- EPD ID: 565b7deb-ebd6-4cb3-9aa6-a585381c41f3	Veracruz	25 February 2023	3	3	3	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	Morelos	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.

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	48.4	0.0847	103	6.9e-06	0.523	0.000406	637
Maximum	410	0.448	583	4.75e-05	9.66	0.00149	3660
Mean	233	0.257	248	1.1e-05	5.44	0.000901	981
Median	220	0.243	234	9e-06	5.15	0.00087	864
60.45NB1218	48.4	0.0847	583	4.75e-05	0.523	0.000864	3660
24005NB0518	88.4	0.0991	103	6.9e-06	2.01	0.000406	637
24007NB0518	88.4	0.0991	103	6.9e-06	2.01	0.000406	637
24010NB0520	100	0.112	113	7e-06	2.3	0.000443	649
24015NB0518	116	0.129	127	7.26e-06	2.66	0.000492	675
24020NB0520	129	0.142	137	7.37e-06	2.97	0.000531	687
68025NB0518	137	0.151	144	7.34e-06	3.18	0.000553	683
24025NB0520	140	0.154	147	7.51e-06	3.23	0.000565	703
24030NB0518	149	0.164	155	7.69e-06	3.45	0.000595	720
77035ND4014	298	0.328	293	1.24e-05	6.98	0.00114	1090
68035NB0518	159	0.175	163	7.6e-06	3.7	0.000621	710
24035NB0518	160	0.176	165	7.83e-06	3.72	0.000629	733
77036ND2010	311	0.342	305	1.25e-05	7.31	0.00118	1100
77038ND2010	328	0.36	319	1.27e-05	7.7	0.00123	1120
77040ND2010	344	0.377	333	1.29e-05	8.09	0.00128	1140
68040ND4014	339	0.372	329	1.28e-05	7.97	0.00127	1130
24040NB0520	168	0.185	171	7.87e-06	3.92	0.000654	739
77042ND4014	364	0.398	350	1.32e-05	8.55	0.00135	1170
77045ND2010	377	0.413	361	1.33e-05	8.88	0.00138	1180
77048ND2010	394	0.43	375	1.35e-05	9.27	0.00143	1200
77050ND2010	410	0.448	389	1.37e-05	9.66	0.00149	1220
76050ND1218	334	0.362	307	8.58e-06	7.88	0.00113	835
24050NB0520	182	0.199	183	8.03e-06	4.23	0.000695	756
24075NB0518	192	0.21	191	8.11e-06	4.47	0.000723	761
70100ND2010	213	0.237	221	1.12e-05	4.97	0.000877	979
76100ND1218	369	0.399	337	9.02e-06	8.72	0.00124	890
73100NB0514	228	0.249	224	8.98e-06	5.33	0.000843	839

71150ND1210	251	0.274	245	9.63e-06	5.87	0.000925	909
40150NB1214	296	0.323	283	1e-05	6.95	0.00106	956
73150NB0514	283	0.309	272	9.7e-06	6.64	0.00102	927

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	703	30.9	667	18.9	0.000967	0.531	15.7	0.00133	0.238	2.75e-05	0.000875	0.0414
Maximum	4000	80	3940	96.9	0.0053	5.52	60.4	0.00474	0.366	2.75e-05	0.000875	0.0414
Mean	1100	55.4	1040	29.3	0.00314	0.82	25.4	0.00196	0.313	2.75e-05	0.000875	0.0414
Median	988	56.6	916	27.1	0.00297	0.654	21.8	0.0017	0.339	2.75e-05	0.000875	0.0414
60.45NB1218	4000	74.5	3940	96.9	0.000967	5.52	60.4	0.00474	0.238	2.75e-05	0.000875	0.0414
24005NB0518	703	30.9	667	18.9	0.00129	0.531	15.7	0.00133	0.349	2.75e-05	0.000875	0.0414
24007NB0518	703	31.6	671	18.9	0.00127	0.531	15.7	0.00133	0.349	2.75e-05	0.000875	0.0414
24010NB0520	719	33.4	680	19.3	0.00141	0.546	16.1	0.00134	0.351	2.75e-05	0.000875	0.0414
24015NB0518	750	35.7	710	20.1	0.00161	0.556	16.7	0.00139	0.343	2.75e-05	0.000875	0.0414
24020NB0520	760	37.7	722	20.7	0.00181	0.572	17.1	0.00141	0.345	2.75e-05	0.000875	0.0414
68025NB0518	757	38.7	720	20.6	0.0019	0.6	17.1	0.0014	0.365	2.75e-05	0.000875	0.0414
24025NB0520	780	39.2	741	21.2	0.00193	0.582	17.5	0.00144	0.343	2.75e-05	0.000875	0.0414
24030NB0518	800	41.6	761	21.7	0.00212	0.586	17.9	0.00147	0.338	2.75e-05	0.000875	0.0414
77035ND4014	1220	63.3	1150	32.7	0.00397	0.658	32.9	0.00243	0.255	2.75e-05	0.000875	0.0414
68035NB0518	795	42.1	749	21.5	0.00222	0.62	17.8	0.00145	0.362	2.75e-05	0.000875	0.0414
24035NB0518	816	42.8	771	22.2	0.00222	0.597	18.3	0.00149	0.336	2.75e-05	0.000875	0.0414
77036ND2010	1240	65.2	1170	33.2	0.00409	0.683	32.9	0.00243	0.265	2.75e-05	0.000875	0.0414
77038ND2010	1260	67.3	1190	33.9	0.00445	0.699	33.5	0.00247	0.264	2.75e-05	0.000875	0.0414
77040ND2010	1280	70.4	1210	34.7	0.00449	0.715	34.2	0.00251	0.262	2.75e-05	0.000875	0.0414
68040ND4014	1270	69.8	1200	34.3	0.00448	0.722	34.1	0.0025	0.276	2.75e-05	0.000875	0.0414

24040NB0520	825	44.1	782	22.4	0.0023	0.609	18.5	0.0015	0.34	2.75e-05	0.000875	0.0414
77042ND4014	1310	73.5	1240	35.5	0.00486	0.723	35.3	0.00257	0.252	2.75e-05	0.000875	0.0414
77045ND2010	1330	75.5	1250	35.8	0.00512	0.75	35.3	0.00258	0.264	2.75e-05	0.000875	0.0414
77048ND2010	1350	78.6	1270	36.6	0.00509	0.768	35.9	0.00261	0.265	2.75e-05	0.000875	0.0414
77050ND2010	1370	80	1290	37.3	0.0053	0.787	36.5	0.00265	0.266	2.75e-05	0.000875	0.0414
76050ND1218	957	66.1	889	26.3	0.00435	0.798	21.2	0.00161	0.366	2.75e-05	0.000875	0.0414
24050NB0520	849	46.3	798	22.9	0.00247	0.624	18.9	0.00153	0.34	2.75e-05	0.000875	0.0414
24075NB0518	854	47.1	803	23.1	0.00259	0.65	19.2	0.00155	0.356	2.75e-05	0.000875	0.0414
70100ND2010	1080	50.6	1030	28.9	0.00293	0.58	29	0.00218	0.265	2.75e-05	0.000875	0.0414
76100ND1218	1020	72.3	944	28.1	0.0047	0.833	22.3	0.00169	0.363	2.75e-05	0.000875	0.0414
73100NB0514	944	54.4	887	25.6	0.00301	0.681	21.4	0.00171	0.343	2.75e-05	0.000875	0.0414
71150ND1210	1020	58.8	959	27.9	0.00342	0.643	22.9	0.00183	0.278	2.75e-05	0.000875	0.0414
40150NB1214	1080	66.2	1020	29.5	0.00385	0.711	24	0.0019	0.299	2.75e-05	0.000875	0.0414
73150NB0514	1050	64.5	981	28.5	0.00386	0.738	23.3	0.00184	0.34	2.75e-05	0.000875	0.0414

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**
Minimum	282	0.308	272	9.92e-06	6.61	0.00102	942
Maximum	367	0.399	345	1.12e-05	8.63	0.00129	1080
Mean	321	0.35	305	1.04e-05	7.55	0.00114	995
Median	318	0.347	302	1.02e-05	7.48	0.00112	980
71175ND1214	282	0.308	272	9.92e-06	6.61	0.00102	942
71200ND1210	289	0.316	278	1.01e-05	6.79	0.00104	959
27200NB1200	367	0.399	345	1.12e-05	8.63	0.00129	1080
73200NB0518	347	0.377	326	1.04e-05	8.17	0.00121	1000

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	1060	63.6	998	29.1	0.00379	0.475	23.8	0.00189	0	2.75e-05	0.000875	0.0414
Maximum	1220	78.4	1140	33.5	0.00484	0.813	27.2	0.00212	0.348	2.75e-05	0.000875	0.0414
Mean	1120	69.8	1050	30.8	0.00425	0.663	25.1	0.00197	0.227	2.75e-05	0.000875	0.0414
Median	1110	68.6	1040	30.4	0.00418	0.683	24.7	0.00194	0.281	2.75e-05	0.000875	0.0414
71175ND1214	1060	63.6	998	29.1	0.00379	0.684	23.8	0.00189	0.287	2.75e-05	0.000875	0.0414
71200ND1210	1080	65.1	1020	29.6	0.0038	0.681	24.2	0.00192	0.275	2.75e-05	0.000875	0.0414
27200NB1200	1220	78.4	1140	33.5	0.00484	0.475	27.2	0.00212	0	2.75e-05	0.000875	0.0414
73200NB0518	1140	72	1060	31.2	0.00456	0.813	25.2	0.00196	0.348	2.75e-05	0.000875	0.0414

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	309	0.337	295	1.02e-05	7.26	0.0011	976
Maximum	387	0.421	360	1.26e-05	9.14	0.00134	1160
Mean	340	0.372	325	1.16e-05	8.01	0.00124	1070
Median	333	0.364	322	1.17e-05	7.82	0.00125	1080
71210ND1214	309	0.337	295	1.02e-05	7.26	0.0011	976
04250ND2012	323	0.354	314	1.25e-05	7.58	0.00122	1110
68250NB1218	343	0.375	331	1.26e-05	8.05	0.00128	1160
73250NB0514	387	0.421	360	1.09e-05	9.14	0.00134	1050

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	1100	67.2	1040	30.2	0.00406	0.697	24.7	0.00194	0.268	2.75e-05	0.000875	0.0414
Maximum	1310	79.7	1240	35.3	0.00499	0.847	33.1	0.00243	0.339	2.75e-05	0.000875	0.0414
Mean	1220	71.3	1140	32.9	0.00444	0.75	29.3	0.00221	0.295	2.75e-05	0.000875	0.0414
Median	1220	69.2	1150	33.2	0.00436	0.727	29.6	0.00224	0.286	2.75e-05	0.000875	0.0414
71210ND1214	1100	67.2	1040	30.2	0.00406	0.711	24.7	0.00194	0.285	2.75e-05	0.000875	0.0414
04250ND2012	1250	67.5	1180	33.5	0.00431	0.697	33.1	0.00243	0.268	2.75e-05	0.000875	0.0414
68250NB1218	1310	70.9	1240	35.3	0.00442	0.743	32.7	0.00242	0.288	2.75e-05	0.000875	0.0414
73250NB0514	1200	79.7	1120	32.8	0.00499	0.847	26.6	0.00205	0.339	2.75e-05	0.000875	0.0414

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**
Minimum	359	0.393	345	1.12e-05	8.45	0.00132	1080
Maximum	446	0.483	410	1.33e-05	10.5	0.00151	1250
Mean	396	0.431	372	1.22e-05	9.32	0.0014	1150
Median	390	0.424	368	1.21e-05	9.16	0.0014	1130
70280NB2014	359	0.393	345	1.28e-05	8.45	0.00132	1150
02300NB2012	376	0.411	361	1.33e-05	8.84	0.0014	1250
40300NB1214	403	0.437	374	1.12e-05	9.49	0.00139	1080
73300NB0518	446	0.483	410	1.14e-05	10.5	0.00151	1110

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	1230	73.9	1150	33.8	0.00472	0.749	27.5	0.00212	0.277	2.75e-05	0.000875	0.0414
Maximum	1400	87.1	1320	37.6	0.00574	0.919	34.6	0.00255	0.351	2.75e-05	0.000875	0.0414
Mean	1300	79.9	1210	35.3	0.00516	0.814	31	0.00232	0.3	2.75e-05	0.000875	0.0414

Median	1280	79.2	1190	34.9	0.00508	0.793	31	0.00232	0.286	2.75e-05	0.000875	0.0414
70280NB2014	1290	73.9	1210	34.9	0.00472	0.749	33.7	0.00247	0.28	2.75e-05	0.000875	0.0414
02300NB2012	1400	76.4	1320	37.6	0.00493	0.769	34.6	0.00255	0.277	2.75e-05	0.000875	0.0414
40300NB1214	1230	82.1	1150	33.8	0.00523	0.817	27.5	0.00212	0.293	2.75e-05	0.000875	0.0414
73300NB0518	1270	87.1	1170	34.9	0.00574	0.919	28.3	0.00216	0.351	2.75e-05	0.000875	0.0414

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	390	0.427	372	1.19e-05	9.19	0.00143	1160
Maximum	486	0.527	451	1.44e-05	11.5	0.00172	1380
Mean	447	0.487	418	1.34e-05	10.6	0.00158	1240
Median	456	0.498	426	1.36e-05	10.8	0.00159	1220
70320ND2010	390	0.427	372	1.34e-05	9.19	0.00143	1200
01350ND2010	432	0.471	407	1.37e-05	10.2	0.00154	1230
60350NB2014	481	0.524	451	1.44e-05	11.4	0.00172	1380
73350NB0514	486	0.527	444	1.19e-05	11.5	0.00164	1160

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	1330	77.4	1230	36.5	0.00522	0.771	29.7	0.00225	0.266	2.75e-05	0.000875	0.0414
Maximum	1560	95	1460	42.1	0.00642	0.954	37.6	0.00275	0.343	2.75e-05	0.000875	0.0414
Mean	1410	87.2	1320	38.2	0.00591	0.854	34.9	0.00256	0.29	2.75e-05	0.000875	0.0414
Median	1380	88.3	1280	37.1	0.006	0.846	36.1	0.00262	0.274	2.75e-05	0.000875	0.0414
70320ND2010	1360	77.4	1270	36.5	0.00522	0.771	35.5	0.00259	0.27	2.75e-05	0.000875	0.0414
01350ND2010	1390	83.5	1300	37.6	0.00562	0.809	36.7	0.00266	0.266	2.75e-05	0.000875	0.0414

60350NB2014	1560	93.1	1460	42.1	0.00639	0.883	37.6	0.00275	0.279	2.75e-05	0.000875	0.0414
73350NB0514	1330	95	1230	36.6	0.00642	0.954	29.7	0.00225	0.343	2.75e-05	0.000875	0.0414

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	450	0.491	422	1.38e-05	10.6	0.0016	1250
Maximum	521	0.569	492	1.7e-05	12.3	0.00188	1520
Mean	486	0.53	457	1.54e-05	11.4	0.00174	1380
Median	486	0.53	457	1.54e-05	11.4	0.00174	1380
70360NB2014	450	0.491	422	1.38e-05	10.6	0.0016	1250
13400ND2010	521	0.569	492	1.7e-05	12.3	0.00188	1520

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	1410	86.3	1330	38.5	0.00597	0.847	36.7	0.00266	0.237	2.75e-05	0.000875	0.0414
Maximum	1720	96.9	1610	46	0.00682	6.89	46	0.00331	0.283	2.75e-05	0.000875	0.0414
Mean	1560	91.6	1470	42.2	0.0064	3.87	41.4	0.00298	0.26	2.75e-05	0.000875	0.0414
Median	1560	91.6	1470	42.2	0.0064	3.87	41.4	0.00298	0.26	2.75e-05	0.000875	0.0414
70360NB2014	1410	86.3	1330	38.5	0.00597	0.847	36.7	0.00266	0.283	2.75e-05	0.000875	0.0414
13400ND2010	1720	96.9	1610	46	0.00682	6.89	46	0.00331	0.237	2.75e-05	0.000875	0.0414

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
13450ND1210	570	0.622	534	1.74e-05	13.5	0.00204	1590

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
13450ND1210	1800	105	1690	48.5	0.00751	6.46	47	0.00337	0.238	2.75e-05	0.000875	0.0414

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
13500ND2012	632	0.689	586	1.8e-05	15	0.00222	1630

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
13500ND2012	1850	114	1740	50.2	0.00827	6.26	48.6	0.00347	0.249	2.75e-05	0.000875	0.0414

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
Minimum	675	0.734	622	1.84e-05	16	0.00236	1710
Maximum	717	0.78	661	1.93e-05	17	0.00252	1860
Mean	696	0.757	642	1.88e-05	16.5	0.00244	1780
Median	696	0.757	642	1.88e-05	16.5	0.00244	1780
13550ND1210	675	0.734	622	1.84e-05	16	0.00236	1710
56550NB1275	717	0.78	661	1.93e-05	17	0.00252	1860

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	1950	123	1830	52.7	0.00878	5.91	49.7	0.00354	0.24	2.75e-05	0.000875	0.0414
Maximum	2120	128	1990	57.4	0.00963	7.25	51.1	0.00367	0.251	2.75e-05	0.000875	0.0414
Mean	2040	126	1910	55	0.0092	6.58	50.4	0.0036	0.246	2.75e-05	0.000875	0.0414
Median	2040	126	1910	55	0.0092	6.58	50.4	0.0036	0.246	2.75e-05	0.000875	0.0414
13550ND1210	1950	123	1830	52.7	0.00878	5.91	49.7	0.00354	0.24	2.75e-05	0.000875	0.0414
56550NB1275	2120	128	1990	57.4	0.00963	7.25	51.1	0.00367	0.251	2.75e-05	0.000875	0.0414

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
13600ND2012	737	0.801	675	1.91e-05	17.5	0.00255	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
13600ND2012	2040	133	1900	55.1	0.00956	5.75	51.5	0.00366	0.239	2.75e-05	0.000875	0.0414

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
60700NB2024	720	0.783	664	1.92e-05	17	0.00252	1850

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
60700NB2024	2110	128	1970	56.9	0.00949	6.24	51.2	0.00366	0.244	2.75e-05	0.000875	0.0414

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.