Environmental Product Declaration

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

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.labelingsustainability.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:	ee7658df-cbbf-483a-914e-c88e12727fe7

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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 56 concrete mixes manufactured at the Holcim Mexico Operaciones S.A. de C.V. Naucalpan 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	3740NB2012	0.039 MPa 28d strength Ready mix concrete	Ready mix concrete	0.039	0.37
2	3742NB2012	0.041 MPa 28d strength Ready mix concrete	Ready mix concrete	0.041	0.40
3	3745NB2012	0.044 MPa 28d strength Ready mix concrete	Ready mix concrete	0.044	0.43
4	3750NB2012	0.049 MPa 28d strength Ready mix concrete	Ready mix concrete	0.049	0.47
5	3755NB2012	0.054 MPa 28d strength Ready mix concrete	Ready mix concrete	0.054	0.53
6	24005NB0524	0.491 MPa 28d strength mortars and fillers	mortars and fillers	0.491	4.29
7	24007NB0518	0.687 MPa 28d strength mortars and fillers	mortars and fillers	0.687	4.45
8	24010NB0518	0.981 MPa 28d strength mortars and fillers	mortars and fillers	0.981	3.89
9	24015NB0518	1.472 MPa 28d strength mortars and fillers	mortars and fillers	1.472	3.21
10	24020NB0524	1.963 MPa 28d strength mortars and fillers	mortars and fillers	1.963	2.86

11	24025NB0514	2.453 MPa 28d strength mortars and fillers	mortars and fillers	2.453	2.62
12	24030NB0518	2.944 MPa 28d strength mortars and fillers	mortars and fillers	2.944	2.39
13	39035ND2010	3.435 MPa 28d strength Ready mix concrete	Ready mix concrete	3.435	0.75
14	24035NB0518	3.435 MPa 28d strength mortars and fillers	mortars and fillers	3.435	2.20
15	39036ND2012	3.533 MPa 28d strength Ready mix concrete	Ready mix concrete	3.533	0.72
16	39038NB2012	3.729 MPa 28d strength Ready mix concrete	Ready mix concrete	3.729	0.68
17	77040ND2006	3.925 MPa 28d strength Ready mix concrete	Ready mix concrete	3.925	0.70
18	24040NB0524	3.925 MPa 28d strength mortars and fillers	mortars and fillers	3.925	2.12
19	77042ND2010	4.122 MPa 28d strength Ready mix concrete	Ready mix concrete	4.122	0.67
20	68042NB2014	4.122 MPa 28d strength special concrete	special concrete	4.122	0.72
21	39045NB2012	4.416 MPa 28d strength Ready mix concrete	Ready mix concrete	4.416	0.60
22	39048ND4012	4.711 MPa 28d strength Ready mix concrete	Ready mix concrete	4.711	0.58
23	39050ND4012	4.907 MPa 28d strength Ready mix concrete	Ready mix concrete	4.907	0.56
24	68050NB0514	4.907 MPa 28d strength special concrete	special concrete	4.907	1.82
25	73050NB0518	4.907 MPa 28d strength mortars and fillers	mortars and fillers	4.907	2.13
26	24060NB0514	5.888 MPa 28d strength mortars and fillers	mortars and fillers	5.888	1.93
27	24075NB0518	7.36 MPa 28d strength mortars and fillers	mortars and fillers	7.360	1.95
28	70100ND2014	9.814 MPa 28d strength Ready mix concrete	Ready mix concrete	9.814	1.17
29	76100NB1218	9.814 MPa 28d strength special concrete	special concrete	9.814	0.83
30	73100NB0518	9.814 MPa 28d strength mortars and fillers	mortars and fillers	9.814	1.59
31	71150ND1210	14.72 MPa 28d strength Ready mix concrete	Ready mix concrete	14.720	0.98
32	40150NB1214	14.72 MPa 28d strength special concrete	special concrete	14.720	1.09
33	73150NB0514	14.72 MPa 28d strength mortars and fillers	mortars and fillers	14.720	1.26

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
34	70175NB2018	17.174 MPa 28d strength Ready mix concrete	Ready mix concrete	17.174	0.93
35	70200NB2014	19.627 MPa 28d strength Ready mix concrete	Ready mix concrete	19.627	0.88
36	27200ND1200	19.627 MPa 28d strength special concrete ,dry mix only	special concrete	19.627	0.00
37	73200NB0514	19.627 MPa 28d strength mortars and fillers	mortars and fillers	19.627	1.04

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
38	71210ND1210	20.608 MPa 28d strength Ready mix concrete	Ready mix concrete	20.608	0.85
39	70250ND2014	24.534 MPa 28d strength Ready mix concrete	Ready mix concrete	24.534	0.78
40	27250NB1200	24.534 MPa 28d strength special concrete ,dry mix only	special concrete	24.534	0.00
41	73250NB0514	24.534 MPa 28d strength mortars and fillers	mortars and fillers	24.534	0.91

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
42	04280NB2018	27.478 MPa 28d strength Ready mix concrete	Ready mix concrete	27.478	0.72
43	01300NB2014	29.441 MPa 28d strength Ready mix concrete	Ready mix concrete	29.441	0.68
44	27300NB1200	29.441 MPa 28d strength special concrete ,dry mix only	special concrete	29.441	0.00
45	73300NB0518	29.441 MPa 28d strength mortars and fillers	mortars and fillers	29.441	0.81

Mix designs: 31 to 35 MPa

Table 5: **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
46	70320ND2010	31.403 MPa 28d strength Ready mix concrete	Ready mix concrete	31.403	0.62
47	70350NB2018	34.347 MPa 28d strength Ready mix concrete	Ready mix concrete	34.347	0.59
48	73350NB0518	34.347 MPa 28d strength mortars and fillers	mortars and fillers	34.347	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
49	04360NB2018	35.329 MPa 28d strength Ready mix concrete	Ready mix concrete	35.329	0.59
50	13400NB1212	39.254 MPa 28d strength Ready mix concrete	Ready mix concrete	39.254	0.44
51	60400NB2018	39.254 MPa 28d strength special concrete	special concrete	39.254	0.42

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
52	60420NB1212	41.217 MPa 28d strength special concrete	special concrete	41.217	0.42
53	13450ND2012	44.161 MPa 28d strength Ready mix concrete	Ready mix concrete	44.161	0.41

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
54	13500NB2012	49.068 MPa 28d strength Ready mix concrete	Ready mix concrete	49.068	0.39

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
55	13550ND2012	53.974 MPa 28d strength Ready mix concrete	Ready mix concrete	53.974	0.35

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
56	13600NB1212	58.881 MPa 28d strength Ready mix concrete	Ready mix concrete	58.881	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 11: **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

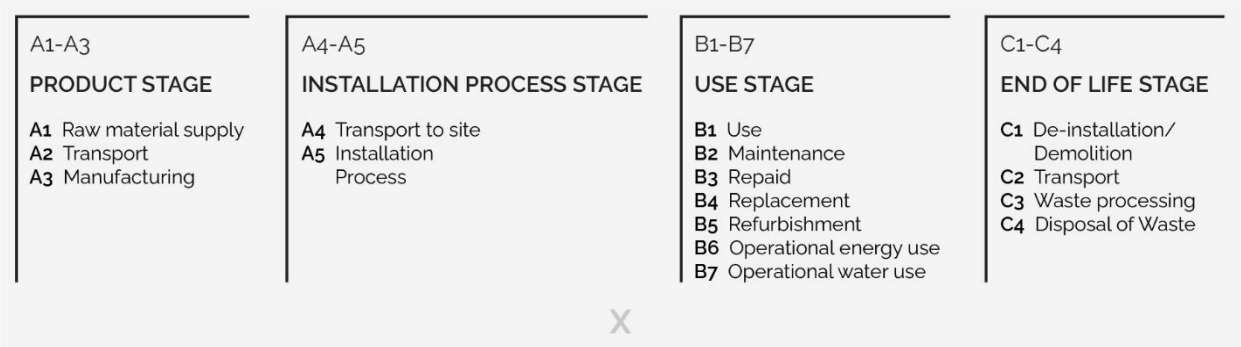


Figure 1: **General life cycle phases for consideration in a construction works system**

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

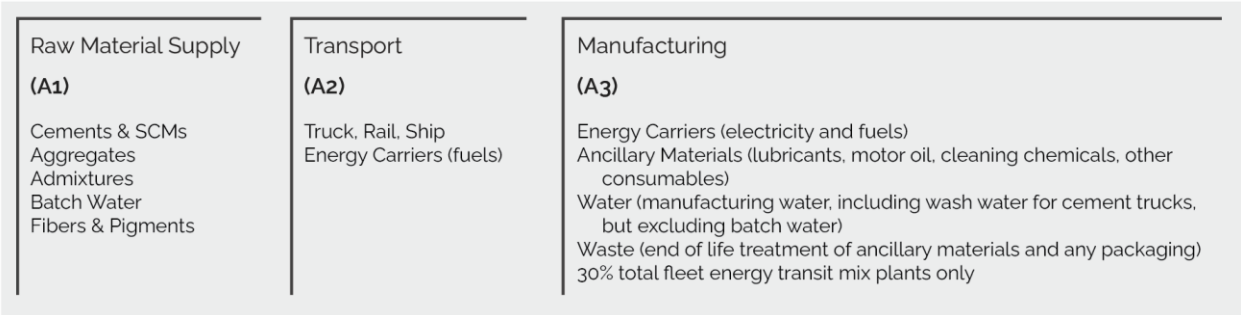
- A1: Raw material supply (upstream processes) - Extraction, handling, and processing of the materials used in manufacturing the declared products in this LCA.
- A2: Transportation - Transportation of A1 materials from the supplier to the "gate" of the manufacturing facility (i.e. A3).
- A3: Manufacturing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

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

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.

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

System Boundary



- 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 Naucalpan 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 12: **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
CPC 40 CEMENT PORTLAND	CPC 40R	Progam Operator: Labeling Sustainability-	Estado de México	very good, 3rd party	3	NA	3	3	3

GRANEL: Apaxco		EPD ID: e38f688d-1fa5-41b0-a9b1-e5b1422ea654		verified facility-specific EPD dataset					
CPC 40R CEMENT PORTLAND GRANEL: Apaxco	CPC 40R	Progam Operator: Labeling Sustainability-EPD ID: e38f688d-1fa5-41b0-a9b1-e5b1422ea654	Estado de México	very good, 3rd party verfied facility-specific EPD dataset	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.

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 13: **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	89.3	0.102	111	8.26e-06	2.01	0.000451	741
Maximum	639	0.692	577	1.5e-05	15.1	0.00216	1420
Mean	287	0.315	281	1.13e-05	6.74	0.00108	1010
Median	283	0.31	279	1.09e-05	6.63	0.00107	1020
3740NB2012	639	0.692	577	1.48e-05	15.1	0.00216	1420
3742NB2012	589	0.639	535	1.43e-05	13.9	0.00201	1360
3745NB2012	545	0.592	498	1.39e-05	12.9	0.00188	1310
3750NB2012	490	0.533	451	1.34e-05	11.6	0.00171	1240
3755NB2012	435	0.474	404	1.28e-05	10.3	0.00154	1180
24005NB0524	95	0.108	114	8.26e-06	2.16	0.000462	741
24007NB0518	89.3	0.102	111	8.49e-06	2.01	0.000451	759
24010NB0518	99.6	0.113	120	8.62e-06	2.26	0.000484	772
24015NB0518	117	0.131	134	8.79e-06	2.67	0.000536	790
24020NB0524	134	0.149	147	8.7e-06	3.07	0.000581	787
24025NB0514	135	0.151	150	9.21e-06	3.09	0.000596	831
24030NB0518	150	0.167	162	9.16e-06	3.46	0.000637	830
39035ND2010	289	0.319	288	1.32e-05	6.78	0.00114	1120

24035NB0518	161	0.178	172	9.3e-06	3.72	0.000671	843
39036ND2012	301	0.332	298	1.32e-05	7.07	0.00118	1130
39038NB2012	316	0.349	311	1.34e-05	7.43	0.00122	1150
77040ND2006	319	0.349	306	1.18e-05	7.49	0.00118	1040
24040NB0524	173	0.191	181	9.15e-06	4.02	0.000702	833
77042ND2010	348	0.381	330	1.2e-05	8.19	0.00127	1050
68042NB2014	354	0.387	335	1.19e-05	8.35	0.00128	1050
39045NB2012	360	0.395	347	1.37e-05	8.48	0.00135	1200
39048ND4012	379	0.417	368	1.5e-05	8.93	0.00144	1300
39050ND4012	396	0.434	381	1.5e-05	9.32	0.00148	1300
68050NB0514	211	0.233	215	9.98e-06	4.93	0.00083	916
73050NB0518	181	0.201	191	9.84e-06	4.21	0.000743	898
24060NB0514	176	0.195	185	9.6e-06	4.09	0.000719	866
24075NB0518	182	0.201	189	9.36e-06	4.23	0.000729	848
70100ND2014	226	0.25	227	1.07e-05	5.28	0.000899	923
76100NB1218	505	0.545	472	1.03e-05	12	0.00173	1020
73100NB0518	236	0.26	237	1.04e-05	5.52	0.00091	961
71150ND1210	276	0.303	280	1.11e-05	6.47	0.00109	970
40150NB1214	286	0.313	279	1.12e-05	6.7	0.00107	1020
73150NB0514	283	0.31	277	1.09e-05	6.63	0.00105	1020

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	813	32.5	768	21.6	0.00133	0.548	19.8	0.00162	0.234	2.5e-05	0.00224	0.0498
Maximum	1630	113	1510	44.4	0.00828	6.31	39.1	0.00291	0.43	2.5e-05	0.00224	0.0498
Mean	1130	60.7	1070	30.5	0.00383	1.48	28.4	0.00217	0.308	2.5e-05	0.00224	0.0498
Median	1140	57.9	1070	30.8	0.0038	0.704	27.5	0.0021	0.319	2.5e-05	0.00224	0.0498
3740NB2012	1630	113	1510	44.4	0.00828	1.01	38.2	0.00279	0.26	2.5e-05	0.00224	0.0498
3742NB2012	1550	104	1450	42.1	0.00761	0.95	36.8	0.0027	0.257	2.5e-05	0.00224	0.0498
3745NB2012	1490	97.4	1390	40.3	0.00709	0.9	35.8	0.00263	0.254	2.5e-05	0.00224	0.0498
3750NB2012	1420	88.8	1320	38.2	0.00637	0.84	34.5	0.00254	0.252	2.5e-05	0.00224	0.0498
3755NB2012	1330	80.3	1250	35.9	0.00577	0.781	33	0.00245	0.251	2.5e-05	0.00224	0.0498
24005NB0524	813	33.1	768	21.6	0.0014	0.567	19.8	0.00162	0.374	2.5e-05	0.00224	0.0498
24007NB0518	829	32.5	794	22.3	0.00133	0.548	20.3	0.00166	0.359	2.5e-05	0.00224	0.0498

24010NB0518	842	34.2	810	22.6	0.00146	0.557	20.7	0.00169	0.357	2.5e-05	0.00224	0.0498
24015NB0518	866	37	824	23.2	0.00167	0.573	21.1	0.00172	0.354	2.5e-05	0.00224	0.0498
24020NB0524	869	39.2	824	23.4	0.00191	0.601	21	0.00169	0.366	2.5e-05	0.00224	0.0498
24025NB0514	914	40.5	867	24.5	0.00197	0.579	22.2	0.0018	0.339	2.5e-05	0.00224	0.0498
24030NB0518	915	42.1	872	24.7	0.00209	0.602	22.1	0.00178	0.348	2.5e-05	0.00224	0.0498
39035ND2010	1250	57.9	1190	33.1	0.00391	4.44	34.3	0.00257	0.234	2.5e-05	0.00224	0.0498
24035NB0518	929	44.2	882	25.1	0.00224	0.613	22.5	0.00181	0.346	2.5e-05	0.00224	0.0498
39036ND2012	1260	60.3	1200	33.4	0.00414	4.41	34.5	0.00257	0.236	2.5e-05	0.00224	0.0498
39038NB2012	1280	63	1220	34	0.00414	4.5	34.9	0.0026	0.234	2.5e-05	0.00224	0.0498
77040ND2006	1160	61.9	1090	30.9	0.00428	0.648	30.5	0.00229	0.242	2.5e-05	0.00224	0.0498
24040NB0524	916	45.4	869	25	0.00237	0.638	22.2	0.00177	0.361	2.5e-05	0.00224	0.0498
77042ND2010	1180	67.7	1110	31.7	0.00464	0.689	31	0.00231	0.252	2.5e-05	0.00224	0.0498
68042NB2014	1180	67.9	1120	31.6	0.00459	0.716	30.9	0.0023	0.272	2.5e-05	0.00224	0.0498
39045NB2012	1330	68.9	1270	35.7	0.00471	4.24	35.7	0.00265	0.234	2.5e-05	0.00224	0.0498
39048ND4012	1460	74	1380	38.7	0.00507	6.31	39	0.0029	0.239	2.5e-05	0.00224	0.0498
39050ND4012	1460	75.6	1380	38.8	0.00523	6.15	39.1	0.00291	0.24	2.5e-05	0.00224	0.0498
68050NB0514	1020	52.5	962	27.5	0.00294	0.704	24.3	0.00193	0.381	2.5e-05	0.00224	0.0498
73050NB0518	991	48.1	948	26.7	0.00254	0.67	23.8	0.00191	0.377	2.5e-05	0.00224	0.0498
24060NB0514	961	47.5	911	26	0.00243	0.62	23.3	0.00187	0.336	2.5e-05	0.00224	0.0498
24075NB0518	942	47.2	889	25.4	0.00249	0.638	22.8	0.00182	0.351	2.5e-05	0.00224	0.0498
70100ND2014	1030	48.7	973	27.1	0.00301	0.586	27.5	0.00209	0.275	2.5e-05	0.00224	0.0498
76100NB1218	1180	89.7	1090	32.6	0.00639	0.858	25.6	0.00189	0.43	2.5e-05	0.00224	0.0498
73100NB0518	1070	56.8	1010	29	0.00321	0.725	25.3	0.002	0.374	2.5e-05	0.00224	0.0498
71150ND1210	1090	55.5	1020	29	0.00359	0.555	28.3	0.00214	0.284	2.5e-05	0.00224	0.0498
40150NB1214	1140	63.2	1070	30.8	0.0038	0.714	27.9	0.00216	0.319	2.5e-05	0.00224	0.0498
73150NB0514	1140	64.8	1070	31.1	0.00381	0.762	26.8	0.0021	0.361	2.5e-05	0.00224	0.0498

Mix designs: 15 to 20 MPa

Table 14: **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	257	0.283	256	1.12e-05	6.01	0.00097	971
Maximum	338	0.369	324	1.15e-05	7.94	0.00122	1090
Mean	294	0.322	285	1.14e-05	6.88	0.00109	1010
Median	290	0.318	280	1.14e-05	6.79	0.00109	990
70175NB2018	289	0.317	280	1.13e-05	6.77	0.00109	985
70200NB2014	290	0.318	281	1.14e-05	6.81	0.00109	994
27200ND1200	257	0.283	256	1.12e-05	6.01	0.00097	971
73200NB0514	338	0.369	324	1.15e-05	7.94	0.00122	1090

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	1080	58	1020	29.4	0.00345	0.354	28.1	0.00218	0	2.5e-05	0.00224	0.0498
Maximum	1220	72.4	1150	33.2	0.00436	0.818	29.3	0.00221	0.359	2.5e-05	0.00224	0.0498
Mean	1130	61.7	1070	30.4	0.00384	0.62	28.7	0.0022	0.228	2.5e-05	0.00224	0.0498
Median	1100	58.2	1050	29.5	0.00377	0.654	28.6	0.0022	0.276	2.5e-05	0.00224	0.0498
70175NB2018	1100	58	1040	29.4	0.00381	0.658	28.9	0.00218	0.281	2.5e-05	0.00224	0.0498
70200NB2014	1110	58.3	1060	29.6	0.00374	0.65	29.3	0.0022	0.271	2.5e-05	0.00224	0.0498
27200ND1200	1080	58.1	1020	29.4	0.00345	0.354	28.1	0.00219	0	2.5e-05	0.00224	0.0498
73200NB0514	1220	72.4	1150	33.2	0.00436	0.818	28.4	0.00221	0.359	2.5e-05	0.00224	0.0498

Mix designs: 21 to 25 MPa

Table 15: **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	313	0.343	306	1.15e-05	7.35	0.00118	1010
Maximum	435	0.473	405	1.27e-05	10.3	0.00149	1140
Mean	364	0.397	347	1.2e-05	8.57	0.00131	1070
Median	353	0.386	339	1.18e-05	8.32	0.00128	1060
71210ND1210	313	0.343	313	1.15e-05	7.35	0.0012	1010
70250ND2014	319	0.35	306	1.17e-05	7.51	0.00118	1020
27250NB1200	435	0.473	405	1.27e-05	10.3	0.00149	1110
73250NB0514	387	0.422	365	1.2e-05	9.12	0.00137	1140

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	1130	61.8	1070	30.3	0.00412	0.534	29.3	0.0022	0	2.5e-05	0.00224	0.0498
Maximum	1290	84.8	1210	35.2	0.00569	0.871	32.5	0.00247	0.36	2.5e-05	0.00224	0.0498
Mean	1210	72.2	1130	32.8	0.00478	0.664	30.4	0.0023	0.226	2.5e-05	0.00224	0.0498
Median	1210	71.1	1120	32.8	0.00466	0.626	29.8	0.00228	0.273	2.5e-05	0.00224	0.0498
71210ND1210	1130	61.8	1070	30.3	0.00412	0.577	29.3	0.0022	0.28	2.5e-05	0.00224	0.0498
70250ND2014	1150	61.8	1080	30.6	0.00416	0.674	30.1	0.00226	0.266	2.5e-05	0.00224	0.0498
27250NB1200	1270	84.8	1170	34.9	0.00569	0.534	32.5	0.00247	0	2.5e-05	0.00224	0.0498
73250NB0514	1290	80.4	1210	35.2	0.00517	0.871	29.6	0.00229	0.36	2.5e-05	0.00224	0.0498

Mix designs: 26 to 30 MPa

Table 16: **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	368	0.403	349	1.22e-05	8.67	0.00135	1080
Maximum	477	0.518	439	1.31e-05	11.3	0.00161	1190
Mean	417	0.454	390	1.25e-05	9.85	0.00147	1140
Median	412	0.448	385	1.24e-05	9.71	0.00145	1140
04280NB2018	368	0.403	349	1.23e-05	8.67	0.00135	1150
01300NB2014	379	0.413	356	1.22e-05	8.92	0.00136	1080
27300NB1200	477	0.518	439	1.31e-05	11.3	0.00161	1140
73300NB0518	445	0.483	414	1.24e-05	10.5	0.00154	1190

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	71.1	1150	32.9	0.00476	0.575	30.8	0.00233	0	2.5e-05	0.00224	0.0498
Maximum	1360	90.8	1270	37.1	0.00628	0.942	33.5	0.00253	0.372	2.5e-05	0.00224	0.0498
Mean	1300	80.6	1210	35.1	0.00544	0.752	31.7	0.00239	0.232	2.5e-05	0.00224	0.0498
Median	1300	80.2	1220	35.2	0.00537	0.746	31.3	0.00235	0.278	2.5e-05	0.00224	0.0498
04280NB2018	1290	71.1	1220	34.5	0.00476	0.747	31.1	0.00233	0.281	2.5e-05	0.00224	0.0498
01300NB2014	1230	71.9	1150	32.9	0.00489	0.745	31.5	0.00234	0.274	2.5e-05	0.00224	0.0498
27300NB1200	1310	90.8	1210	36	0.00628	0.575	33.5	0.00253	0	2.5e-05	0.00224	0.0498
73300NB0518	1360	88.6	1270	37.1	0.00585	0.942	30.8	0.00236	0.372	2.5e-05	0.00224	0.0498

Mix designs: 31 to 35 MPa

Table 17: **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	387	0.422	363	1.24e-05	9.11	0.00138	1100
Maximum	494	0.536	454	1.28e-05	11.7	0.00168	1220
Mean	441	0.48	409	1.26e-05	10.4	0.00154	1150
Median	442	0.481	409	1.27e-05	10.4	0.00155	1140
70320ND2010	387	0.422	363	1.24e-05	9.11	0.00138	1100
70350NB2018	442	0.481	409	1.27e-05	10.4	0.00155	1140
73350NB0518	494	0.536	454	1.28e-05	11.7	0.00168	1220

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	1240	73.3	1170	33.3	0.00508	0.738	31.9	0.00239	0.259	2.5e-05	0.00224	0.0498
Maximum	1400	94	1300	38.2	0.00644	0.994	33	0.00244	0.374	2.5e-05	0.00224	0.0498
Mea3	1310	82.9	1230	35.5	0.00574	0.85	32.3	0.00242	0.304	2.5e-05	0.00224	0.0498
Median	1300	81.5	1210	35.1	0.00571	0.818	32.1	0.00243	0.28	2.5e-05	0.00224	0.0498
70320ND2010	1240	73.3	1170	33.3	0.00508	0.738	32.1	0.00239	0.259	2.5e-05	0.00224	0.0498
70350NB2018	1300	81.5	1210	35.1	0.00571	0.818	33	0.00244	0.28	2.5e-05	0.00224	0.0498
73350NB0518	1400	94	1300	38.2	0.00644	0.994	31.9	0.00243	0.374	2.5e-05	0.00224	0.0498

Mix designs: 36 to 40 MPa

Table 18: **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	454	0.494	422	1.31e-05	10.7	0.00162	1250
Maximum	518	0.565	508	1.65e-05	12.2	0.00194	1510
Mean	486	0.53	468	1.48e-05	11.5	0.00179	1370
Median	486	0.53	474	1.49e-05	11.5	0.00181	1360
04360NB2018	454	0.494	422	1.31e-05	10.7	0.00162	1250
13400NB1212	486	0.53	474	1.49e-05	11.5	0.00181	1360
60400NB2018	518	0.565	508	1.65e-05	12.2	0.00194	1510

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	1420	85.8	1330	38	0.00601	0.841	33.4	0.00248	0.236	2.5e-05	0.00224	0.0498
Maximum	1700	96.3	1600	45.5	0.00675	6.64	42	0.00311	0.284	2.5e-05	0.00224	0.0498
Mean	1550	89.7	1460	41.6	0.0064	3.85	37.8	0.0028	0.253	2.5e-05	0.00224	0.0498
Median	1530	87.1	1440	41.2	0.00645	4.06	38.1	0.00281	0.239	2.5e-05	0.00224	0.0498
04360NB2018	1420	85.8	1330	38	0.00601	0.841	33.4	0.00248	0.284	2.5e-05	0.00224	0.0498
13400NB1212	1530	87.1	1440	41.2	0.00645	4.06	38.1	0.00281	0.236	2.5e-05	0.00224	0.0498
60400NB2018	1700	96.3	1600	45.5	0.00675	6.64	42	0.00311	0.239	2.5e-05	0.00224	0.0498

Mix designs: 41 to 45 MPa

Table 19: **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**

b) 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	545	0.592	510	1.39e-05	12.9	0.00194	1290
Maximum	553	0.602	519	1.53e-05	13.1	0.00196	1420
Mean	549	0.597	514	1.46e-05	13	0.00195	1360
Median	549	0.597	514	1.46e-05	13	0.00195	1360
60420NB1212	545	0.592	519	1.39e-05	12.9	0.00196	1290
13450ND2012	553	0.602	510	1.53e-05	13.1	0.00194	1420

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	1480	94.3	1380	39.8	0.00688	0.703	35.4	0.00259	0.249	2.5e-05	0.00224	0.0498
Maximum	1610	99.5	1510	43.3	0.00718	3.65	39.7	0.00291	0.249	2.5e-05	0.00224	0.0498
Mean	1540	96.9	1440	41.6	0.00699	2.18	37.6	0.00275	0.249	2.5e-05	0.00224	0.0498
Median	1540	96.9	1440	41.6	0.00699	2.18	37.6	0.00275	0.249	2.5e-05	0.00224	0.0498
60420NB1212	1480	94.3	1380	39.8	0.00688	0.703	35.4	0.00259	0.249	2.5e-05	0.00224	0.0498
13450ND2012	1610	99.5	1510	43.3	0.00718	3.65	39.7	0.00291	0.249	2.5e-05	0.00224	0.0498

Mix designs: 46 to 50 MPa

Table 20: **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	604	0.657	553	1.57e-05	14.3	0.00209	1470

Maximum	604	0.657	553	1.57e-05	14.3	0.00209	1470
Mean	604	0.657	553	1.57e-05	14.3	0.00209	1470
Median	604	0.657	553	1.57e-05	14.3	0.00209	1470
13500NB2012	604	0.657	553	1.57e-05	14.3	0.00209	1470

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	1670	106	1560	45.1	0.00791	3.72	40.9	0.00299	0.255	2.5e-05	0.00224	0.0498
Maximum	1670	106	1560	45.1	0.00791	3.72	40.9	0.00299	0.255	2.5e-05	0.00224	0.0498
Mean	1670	106	1560	45.1	0.00791	3.72	40.9	0.00299	0.255	2.5e-05	0.00224	0.0498
Median	1670	106	1560	45.1	0.00791	3.72	40.9	0.00299	0.255	2.5e-05	0.00224	0.0498
13500NB2012	1670	106	1560	45.1	0.00791	3.72	40.9	0.00299	0.255	2.5e-05	0.00224	0.0498

Mix designs: 51 to 55 MPa

Table 21: **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	647	0.702	589	1.62e-05	15.3	0.00222	1540
Maximum	647	0.702	589	1.62e-05	15.3	0.00222	1540
Mean	647	0.702	589	1.62e-05	15.3	0.00222	1540
Median	647	0.702	589	1.62e-05	15.3	0.00222	1540
13550ND2012	647	0.702	589	1.62e-05	15.3	0.00222	1540

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	1760	116	1640	47.3	0.00835	3.43	41.8	0.00306	0.247	2.5e-05	0.00224	0.0498

Maximum	1760	116	1640	47.3	0.00835	3.43	41.8	0.00306	0.247	2.5e-05	0.00224	0.0498
Mean	1760	116	1640	47.3	0.00835	3.43	41.8	0.00306	0.247	2.5e-05	0.00224	0.0498
Median	1760	116	1640	47.3	0.00835	3.43	41.8	0.00306	0.247	2.5e-05	0.00224	0.0498
13550ND2012	1760	116	1640	47.3	0.00835	3.43	41.8	0.00306	0.247	2.5e-05	0.00224	0.0498

Mix designs: 56 to 60 MPa

Table 22: **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**
Minimum	718	0.778	679	1.7e-05	17	0.00254	1640
Maximum	718	0.778	679	1.7e-05	17	0.00254	1640
Mean	718	0.778	679	1.7e-05	17	0.00254	1640
Median	718	0.778	679	1.7e-05	17	0.00254	1640
13600NB1212	718	0.778	679	1.7e-05	17	0.00254	1640

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	1880	123	1750	50.9	0.00914	3.49	42.9	0.00314	0.242	2.5e-05	0.00224	0.0498
Maximum	1880	123	1750	50.9	0.00914	3.49	42.9	0.00314	0.242	2.5e-05	0.00224	0.0498
Mean	1880	123	1750	50.9	0.00914	3.49	42.9	0.00314	0.242	2.5e-05	0.00224	0.0498
Median	1880	123	1750	50.9	0.00914	3.49	42.9	0.00314	0.242	2.5e-05	0.00224	0.0498
13600NB1212	1880	123	1750	50.9	0.00914	3.49	42.9	0.00314	0.242	2.5e-05	0.00224	0.0498

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.