Environmental Product Declaration

Environmental Product Declaration for various ready mix concrete products produced by Holcim México Operaciones S.A. de C.V. at their Xalostoc facility in Ecatepec, Estado 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)
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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 59 concrete mixes manufactured at the Holcim Mexico Operaciones S.A. de C.V. Xalostoc concrete facility in Estado de México, 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	37.40NB2012	0.039 MPa 28d strength Ready mix concrete	Ready mix concrete	0.039	0.34
2	37.42NB2012	0.041 MPa 28d strength Ready mix concrete	Ready mix concrete	0.041	0.38
3	37.45NB2012	0.044 MPa 28d strength Ready mix concrete	Ready mix concrete	0.044	0.41
4	37.50NB2012	0.049 MPa 28d strength Ready mix concrete	Ready mix concrete	0.049	0.45
5	37.55NB2012	0.054 MPa 28d strength Ready mix concrete	Ready mix concrete	0.054	0.51
6	24005NB0524	0.491 MPa 28d strength mortars and fillers	Mortars and fillers	0.491	5.52
7	60007NB1218	0.687 MPa 28d strength special concrete	Special concrete	0.687	3.02
8	24007NB0524	0.687 MPa 28d strength mortars and fillers	Mortars and fillers	0.687	5.52
9	24010NB0524	0.981 MPa 28d strength mortars and fillers	Mortars and fillers	0.981	4.73
10	24015NB0518	1.472 MPa 28d strength mortars and fillers	Mortars and fillers	1.472	3.87

11	24020NB0524	1.963 MPa 28d strength mortars and fillers	Mortars and fillers	1.963	3.38
12	60025NB1218	2.453 MPa 28d strength special concrete	Special concrete	2.453	2.04
13	24025NB0524	2.453 MPa 28d strength mortars and fillers	Mortars and fillers	2.453	3.03
14	24030NB0524	2.944 MPa 28d strength mortars and fillers	Mortars and fillers	2.944	2.75
15	77035ND2010	3.435 MPa 28d strength Ready mix concrete	Ready mix concrete	3.435	0.87
16	24035NB0524	3.435 MPa 28d strength mortars and fillers	Mortars and fillers	3.435	2.52
17	39036ND4010	3.533 MPa 28d strength Ready mix concrete	Ready mix concrete	3.533	0.73
18	39038ND2012	3.729 MPa 28d strength Ready mix concrete	Ready mix concrete	3.729	0.68
19	77040ND2006	3.925 MPa 28d strength Ready mix concrete	Ready mix concrete	3.925	0.72
20	24040NB0524	3.925 MPa 28d strength mortars and fillers	Mortars and fillers	3.925	2.40
21	77042ND2006	4.122 MPa 28d strength Ready mix concrete	Ready mix concrete	4.122	0.68
22	68042ND4010	4.122 MPa 28d strength special concrete	Special concrete	4.122	0.67
23	39045ND4010	4.416 MPa 28d strength Ready mix concrete	Ready mix concrete	4.416	0.60
24	60045ND4012	4.416 MPa 28d strength special concrete	Special concrete	4.416	0.61
25	77048NB4014	4.711 MPa 28d strength Ready mix concrete	Ready mix concrete	4.711	0.63
26	77050NB4014	4.907 MPa 28d strength Ready mix concrete	Ready mix concrete	4.907	0.61
27	73050NB0518	4.907 MPa 28d strength mortars and fillers	Mortars and fillers	4.907	1.98
28	24060NB0514	5.888 MPa 28d strength mortars and fillers	Mortars and fillers	5.888	1.74
29	24075NB0518	7.36 MPa 28d strength mortars and fillers	Mortars and fillers	7.360	1.95
30	70100ND2014	9.814 MPa 28d strength Ready mix concrete	Ready mix concrete	9.814	1.22
31	60100ND2010	9.814 MPa 28d strength special concrete	Special concrete	9.814	0.65
32	73100NB0518	9.814 MPa 28d strength mortars and fillers	Mortars and fillers	9.814	1.48
33	70150ND2014	14.72 MPa 28d strength Ready mix concrete	Ready mix concrete	14.720	1.01
34	40150NB1214	14.72 MPa 28d strength special concrete	Special concrete	14.720	1.09
35	73150NB0518	14.72 MPa 28d strength mortars and fillers	Mortars and fillers	14.720	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
36	71175ND1214	17.174 MPa 28d strength Ready mix concrete	Ready mix concrete	17.174	0.96
37	70200ND2014	19.627 MPa 28d strength Ready mix concrete	Ready mix concrete	19.627	0.86
38	40200NB1214	19.627 MPa 28d strength special concrete	Special concrete	19.627	0.96
39	73200NB0514	19.627 MPa 28d strength mortars and fillers	Mortars and fillers	19.627	0.97

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
40	71210ND1214	20.608 MPa 28d strength Ready mix concrete	Ready mix concrete	20.608	0.88
41	02250ND2010	24.534 MPa 28d strength Ready mix concrete	Ready mix concrete	24.534	0.83
42	40250NB1210	24.534 MPa 28d strength special concrete	Special concrete	24.534	0.87
43	73250NB0514	24.534 MPa 28d strength mortars and fillers	Mortars and fillers	24.534	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
44	07280ND1210	27.478 MPa 28d strength Ready mix concrete	Ready mix concrete	27.478	0.73
45	70300ND2014	29.441 MPa 28d strength Ready mix concrete	Ready mix concrete	29.441	0.67
46	56300NB1265	29.441 MPa 28d strength special concrete	Special concrete	29.441	0.44
47	73300NB0518	29.441 MPa 28d strength mortars and fillers	Mortars and fillers	29.441	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
48	70320ND2010	31.403 MPa 28d strength Ready mix concrete	Ready mix concrete	31.403	0.63
49	71350NB1214	34.347 MPa 28d strength Ready mix concrete	Ready mix concrete	34.347	0.62
50	56350NB1265	34.347 MPa 28d strength special concrete	Special concrete	34.347	0.42
51	73350NB0514	34.347 MPa 28d strength mortars and fillers	Mortars and fillers	34.347	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
52	04360ND2010	35.329 MPa 28d strength Ready mix concrete	Ready mix concrete	35.329	0.53
53	13400NB1212	39.254 MPa 28d strength Ready mix concrete	Ready mix concrete	39.254	0.47
54	60400NB2018	39.254 MPa 28d strength special concrete	Special concrete	39.254	0.40

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
55	13450ND2012	44.161 MPa 28d strength Ready mix concrete	Ready mix concrete	44.161	0.4

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
56	13500NB2018	49.068 MPa 28d strength Ready mix concrete	Ready mix concrete	49.068	0.38

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
57	13550NB1212	53.974 MPa 28d strength Ready mix concrete	Ready mix concrete	53.974	0.36

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
58	13600NB2012	58.881 MPa 28d strength Ready mix concrete	Ready mix concrete	58.881	0.31
59	60600NB1224	58.881 MPa 28d strength special concrete	Special concrete	58.881	0.28

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

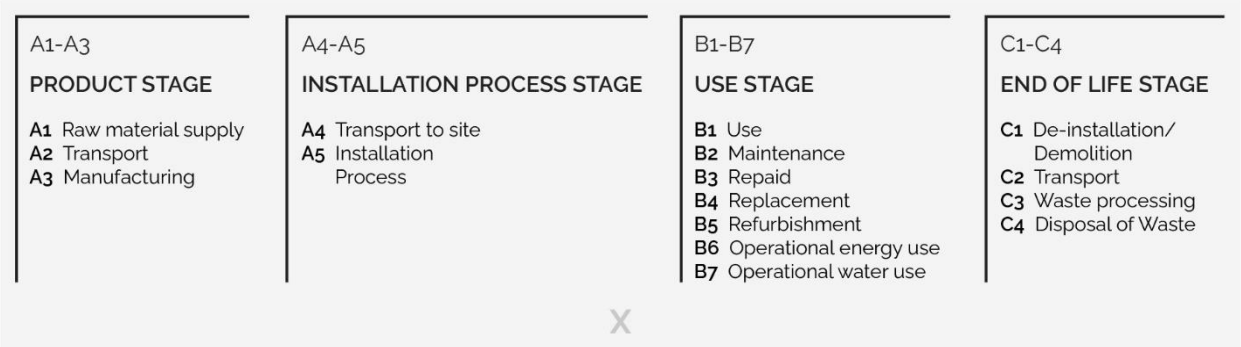

Figure 1: **General life cycle phases for consideration in a construction works system**

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.

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

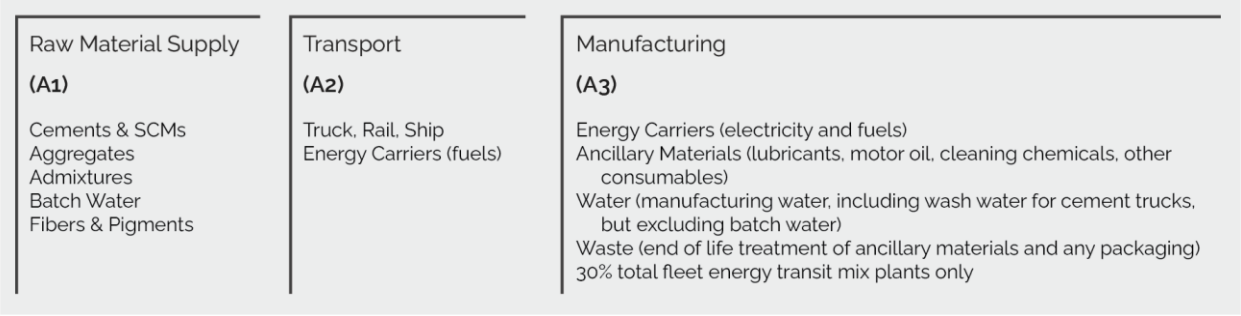

Figure 2: **General system inputs considered in the product system and categorized by modules in scope**

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 Xalostoc 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

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, Hidalgo	v3.8 in 2021	2	3	1	3	3
Fly Ash	Waste input produced off-site	See A3 inputs	Coahuila	See A3 inputs	2	A3	2	A3	A3

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 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	21.3	0.0399	88.2	6.12e-06	0.272	0.000351	553
Maximum	403	0.439	652	5.23e-05	9.51	0.00142	4020
Mean	154	0.178	281	1.82e-05	3.45	0.000768	1460
Median	125	0.138	271	1.08e-05	2.9	0.000695	925
37.40NB2012	52.6	0.0922	652	5.23e-05	0.561	0.000942	4020
37.42NB2012	48.8	0.0859	594	4.85e-05	0.527	0.000884	3720
37.45NB2012	45.4	0.0801	541	4.5e-05	0.497	0.000831	3440
37.50NB2012	42.2	0.0746	490	4.17e-05	0.467	0.00078	3180
37.55NB2012	39.1	0.0693	442	3.85e-05	0.439	0.000731	2930
24005NB0524	75.6	0.0852	88.2	6.12e-06	1.72	0.000351	553
60007NB1218	21.3	0.0399	181	2.15e-05	0.272	0.000467	1600
24007NB0524	75.6	0.0852	88.2	6.12e-06	1.72	0.000351	553
24010NB0524	86	0.0962	97	6.24e-06	1.96	0.000383	566
24015NB0518	98.1	0.109	108	6.59e-06	2.25	0.000425	598
24020NB0524	114	0.127	121	6.57e-06	2.63	0.00047	600
60025NB1218	23.6	0.0437	225	2.4e-05	0.289	0.000494	1790
24025NB0524	125	0.138	130	6.7e-06	2.9	0.000504	614
24030NB0524	136	0.15	140	6.83e-06	3.16	0.000538	627
77035ND2010	282	0.309	271	1.08e-05	6.62	0.00106	925
24035NB0524	147	0.162	149	6.95e-06	3.42	0.000571	639
39036ND4010	31.5	0.0556	335	3.02e-05	0.365	0.000583	2260
39038ND2012	33.5	0.0599	359	3.3e-05	0.389	0.000638	2470
77040ND2006	318	0.349	302	1.13e-05	7.49	0.00117	974
24040NB0524	154	0.169	155	7.02e-06	3.58	0.000591	647
77042ND2006	335	0.366	316	1.14e-05	7.88	0.00122	986
68042ND4010	34.1	0.0586	384	3.18e-05	0.386	0.000581	2410
39045ND4010	35.5	0.0625	399	3.44e-05	0.402	0.000644	2580
60045ND4012	386	0.421	360	1.18e-05	9.11	0.00138	1080
77048NB4014	386	0.421	359	1.18e-05	9.12	0.00137	1030
77050NB4014	403	0.439	373	1.19e-05	9.51	0.00142	1050

73050NB0518	181	0.199	180	7.81e-06	4.22	0.000688	728
24060NB0514	186	0.204	183	7.68e-06	4.34	0.000695	711
24075NB0518	180	0.197	177	7.3e-06	4.21	0.00067	672
70100ND2014	209	0.231	208	9.77e-06	4.89	0.000832	828
60100ND2010	37.1	0.0672	394	3.73e-05	0.426	0.00075	2810
73100NB0518	236	0.258	227	8.42e-06	5.53	0.000857	795
70150ND2014	247	0.272	241	1.02e-05	5.8	0.00095	872
40150NB1214	294	0.32	276	9.06e-06	6.92	0.00103	858
73150NB0518	291	0.317	274	9.02e-06	6.85	0.00103	861

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	611	26.5	581	16.4	0.000569	0.534	13.9	0.00116	0.225	2.58e-05	0.00564	0.0842
Maximum	4410	80.8	4320	106	0.00522	13.8	63.9	0.00497	0.376	2.58e-05	0.00564	0.0842
Mean	1610	49.9	1560	40.5	0.00215	2.74	31.7	0.00244	0.3	2.58e-05	0.00564	0.0842
Median	1040	49.4	987	27.6	0.00173	0.664	28.5	0.00208	0.267	2.58e-05	0.00564	0.0842
37.40NB2012	4410	80.8	4320	106	0.00102	5.65	63.9	0.00497	0.234	2.58e-05	0.00564	0.0842
37.42NB2012	4060	73.8	4000	97.9	0.000952	6.03	61.2	0.00474	0.231	2.58e-05	0.00564	0.0842
37.45NB2012	3760	68	3700	90.9	0.000902	6.43	58.6	0.00453	0.228	2.58e-05	0.00564	0.0842
37.50NB2012	3460	62.9	3410	84	0.000854	6.83	56.3	0.00434	0.226	2.58e-05	0.00564	0.0842
37.55NB2012	3210	57.3	3140	77.5	0.000808	7.24	54	0.00415	0.225	2.58e-05	0.00564	0.0842
24005NB0524	613	26.5	581	16.4	0.00108	0.534	13.9	0.00116	0.376	2.58e-05	0.00564	0.0842
60007NB1218	1750	29.2	1710	43.1	0.000569	13.8	42.9	0.00322	0.364	2.58e-05	0.00564	0.0842
24007NB0524	611	26.7	583	16.4	0.0011	0.534	13.9	0.00116	0.376	2.58e-05	0.00564	0.0842
24010NB0524	629	28.3	599	16.8	0.00123	0.544	14.2	0.00118	0.374	2.58e-05	0.00564	0.0842
24015NB0518	667	30.8	633	17.8	0.00139	0.541	15.1	0.00125	0.356	2.58e-05	0.00564	0.0842
24020NB0524	669	32.9	634	17.9	0.00161	0.569	15.1	0.00124	0.369	2.58e-05	0.00564	0.0842
60025NB1218	1950	33.6	1920	48	0.00059	12.8	43.3	0.00327	0.355	2.58e-05	0.00564	0.0842
24025NB0524	687	34.8	650	18.4	0.00173	0.579	15.5	0.00127	0.367	2.58e-05	0.00564	0.0842

24030NB05 24	701	35.9	667	18.8	0.00187	0.589	15.8	0.00129	0.365	2.58e-05	0.00564	0.0842
77035ND20 10	1040	55.4	987	27.6	0.00368	0.623	28.5	0.00208	0.26	2.58e-05	0.00564	0.0842
24035NB05 24	715	38.2	677	19.3	0.00205	0.599	16.2	0.00131	0.363	2.58e-05	0.00564	0.0842
39036ND40 10	2470	43.8	2430	59.7	0.000633	3.81	44.4	0.00339	0.235	2.58e-05	0.00564	0.0842
39038ND20 12	2700	48.1	2660	65.8	0.00072	7.68	49.8	0.0038	0.232	2.58e-05	0.00564	0.0842
77040ND20 06	1100	60.2	1040	29.3	0.00421	0.647	29.8	0.00217	0.247	2.58e-05	0.00564	0.0842
24040NB05 24	727	39.6	684	19.6	0.00207	0.606	16.4	0.00133	0.363	2.58e-05	0.00564	0.0842
77042ND20 06	1120	62.7	1060	29.8	0.00433	0.664	30.3	0.00219	0.247	2.58e-05	0.00564	0.0842
68042ND40 10	2630	49.4	2590	63.4	0.000629	0.546	41	0.0032	0.258	2.58e-05	0.00564	0.0842
39045ND40 10	2810	50.8	2770	68.3	0.000695	3.45	47.5	0.00365	0.238	2.58e-05	0.00564	0.0842
60045ND40 12	1230	73.9	1150	32.9	0.00493	0.734	30.6	0.00224	0.254	2.58e-05	0.00564	0.0842
77048NB40 14	1170	72.7	1100	31.3	0.00512	0.734	31.2	0.00225	0.262	2.58e-05	0.00564	0.0842
77050NB40 14	1200	74.4	1120	32	0.00522	0.752	31.6	0.00228	0.264	2.58e-05	0.00564	0.0842
73050NB05 18	818	43.9	773	22.1	0.00248	0.634	18.2	0.00147	0.356	2.58e-05	0.00564	0.0842
24060NB05 14	802	45.3	756	21.7	0.0025	0.605	18	0.00145	0.326	2.58e-05	0.00564	0.0842
24075NB05 18	758	42.9	711	20.5	0.00237	0.621	17.2	0.00138	0.351	2.58e-05	0.00564	0.0842
70100ND20 14	927	44	884	24.5	0.00275	0.552	25.6	0.00189	0.267	2.58e-05	0.00564	0.0842
60100ND20 10	3070	54.1	3020	74.9	0.000853	7.14	59.6	0.00446	0.236	2.58e-05	0.00564	0.0842
73100NB05 18	899	53.3	848	24.5	0.00316	0.69	19.8	0.00158	0.353	2.58e-05	0.00564	0.0842
70150ND20 14	981	49.5	931	25.9	0.00333	0.59	26.8	0.00197	0.265	2.58e-05	0.00564	0.0842
40150NB12 14	981	62.6	916	26.7	0.0039	0.727	21.6	0.0017	0.33	2.58e-05	0.00564	0.0842
73150NB05 18	981	61.9	915	26.7	0.00398	0.745	21.4	0.00169	0.35	2.58e-05	0.00564	0.0842

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	279	0.306	267	9.44e-06	6.56	0.00104	898
Maximum	337	0.366	313	1.06e-05	7.94	0.00117	923
Mean	307	0.335	289	1e-05	7.22	0.0011	910
Median	306	0.334	288	1e-05	7.2	0.0011	909
71175ND1214	279	0.306	267	1.04e-05	6.56	0.00104	900
70200ND2014	286	0.314	274	1.06e-05	6.72	0.00107	918
40200NB1214	326	0.354	303	9.44e-06	7.68	0.00113	898
73200NB0514	337	0.366	313	9.6e-06	7.94	0.00117	923

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	1020	55.5	957	27	0.00366	0.629	22.6	0.00176	0.262	2.58e-05	0.00564	0.0842
Maximum	1050	69.5	983	28.8	0.00442	0.782	28	0.00204	0.338	2.58e-05	0.00564	0.0842
Mean	1040	61.8	970	27.8	0.00402	0.702	25.2	0.0019	0.302	2.58e-05	0.00564	0.0842
Median	1040	61	970	27.7	0.004	0.698	25.2	0.0019	0.304	2.58e-05	0.00564	0.0842
71175ND1214	1020	55.5	959	27	0.00366	0.641	27.4	0.002	0.282	2.58e-05	0.00564	0.0842
70200ND2014	1040	55.9	980	27.5	0.00372	0.629	28	0.00204	0.262	2.58e-05	0.00564	0.0842
40200NB1214	1030	66.1	957	27.9	0.00429	0.756	22.6	0.00176	0.325	2.58e-05	0.00564	0.0842
73200NB0514	1050	69.5	983	28.8	0.00442	0.782	22.9	0.00179	0.338	2.58e-05	0.00564	0.0842

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	30.9	0.0528	287	9.76e-06	0.357	0.000524	927
Maximum	386	0.419	355	2.83e-05	9.12	0.00132	2140
Mean	268	0.297	326	1.47e-05	6.23	0.00104	1240

Median	328	0.358	330	1.04e-05	7.72	0.00116	951
71210ND1214	302	0.331	287	1.07e-05	7.11	0.00111	927
02250ND2010	30.9	0.0528	334	2.83e-05	0.357	0.000524	2140
40250NB1210	353	0.384	327	9.76e-06	8.33	0.00121	928
73250NB0514	386	0.419	355	1.01e-05	9.12	0.00132	974

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	1050	44.3	988	28	0.000581	0.529	23.5	0.00182	0.271	2.58e-05	0.00564	0.0842
Maximum	2340	75.5	2290	56.3	0.00506	0.835	37.5	0.00293	0.339	2.58e-05	0.00564	0.0842
Mean	1390	62	1320	36	0.00355	0.702	28.4	0.00217	0.302	2.58e-05	0.00564	0.0842
Median	1090	64.2	1010	29.8	0.00428	0.721	26.2	0.00196	0.3	2.58e-05	0.00564	0.0842
71210ND1214	1050	57.8	988	28	0.00393	0.663	28.1	0.00204	0.28	2.58e-05	0.00564	0.0842
02250ND2010	2340	44.3	2290	56.3	0.000581	0.529	37.5	0.00293	0.271	2.58e-05	0.00564	0.0842
40250NB1210	1060	70.6	991	29.1	0.00463	0.779	23.5	0.00182	0.319	2.58e-05	0.00564	0.0842
73250NB0514	1120	75.5	1030	30.6	0.00506	0.835	24.3	0.00188	0.339	2.58e-05	0.00564	0.0842

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	49.3	0.0872	334	1.06e-05	0.537	0.00093	997
Maximum	445	0.482	588	4.91e-05	10.5	0.00149	3820
Mean	304	0.339	416	2.06e-05	7	0.00125	1710
Median	360	0.393	372	1.14e-05	8.49	0.00129	1020
07280ND1210	357	0.39	334	1.14e-05	8.42	0.00128	997
70300ND2014	363	0.396	339	1.14e-05	8.56	0.0013	1000
56300NB1265	49.3	0.0872	588	4.91e-05	0.537	0.00093	3820
73300NB0518	445	0.482	404	1.06e-05	10.5	0.00149	1030

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	67.2	1060	30.3	0.00102	0.709	25.7	0.00197	0.259	2.58e-05	0.00564	0.0842
Maximum	4190	83.7	4100	101	0.0058	8.84	64	0.00496	0.351	2.58e-05	0.00564	0.0842
Mean	1910	73.9	1830	48.6	0.00408	2.79	37.5	0.00282	0.288	2.58e-05	0.00564	0.0842
Median	1160	72.4	1080	31.5	0.00476	0.814	30.1	0.00218	0.27	2.58e-05	0.00564	0.0842
07280ND1210	1130	67.2	1060	30.3	0.0047	0.721	30	0.00217	0.279	2.58e-05	0.00564	0.0842
70300ND2014	1140	68.5	1070	30.5	0.00481	0.709	30.2	0.00219	0.262	2.58e-05	0.00564	0.0842
56300NB1265	4190	76.2	4100	101	0.00102	8.84	64	0.00496	0.259	2.58e-05	0.00564	0.0842
73300NB0518	1190	83.7	1090	32.5	0.0058	0.907	25.7	0.00197	0.351	2.58e-05	0.00564	0.0842

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	49.3	0.0871	351	1.11e-05	0.536	0.000922	1020
Maximum	485	0.525	589	4.91e-05	11.5	0.00161	3800
Mean	338	0.375	445	2.1e-05	7.83	0.00135	1740
Median	408	0.444	420	1.18e-05	9.65	0.00143	1070
70320ND2010	377	0.411	351	1.16e-05	8.9	0.00134	1020
71350NB1214	440	0.478	403	1.2e-05	10.4	0.00152	1070
56350NB1265	49.3	0.0871	589	4.91e-05	0.536	0.000922	3800
73350NB0514	485	0.525	438	1.11e-05	11.5	0.00161	1070

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	1170	70.3	1090	31.1	0.00104	0.717	27	0.00206	0.25	2.58e-05	0.00564	0.0842
Maximum	4160	92.7	4080	101	0.00624	8.73	64	0.00496	0.343	2.58e-05	0.00564	0.0842
Mean	1950	79.4	1860	49.8	0.00447	2.8	38.4	0.00288	0.284	2.58e-05	0.00564	0.0842
Median	1240	77.4	1140	33.4	0.0053	0.88	31.2	0.00225	0.272	2.58e-05	0.00564	0.0842
70320ND2010	1170	70.3	1090	31.1	0.00493	0.717	30.8	0.00223	0.255	2.58e-05	0.00564	0.0842
71350NB1214	1230	79.6	1140	32.9	0.00567	0.817	31.6	0.00227	0.289	2.58e-05	0.00564	0.0842
56350NB1265	4160	75.2	4080	101	0.00104	8.73	64	0.00496	0.25	2.58e-05	0.00564	0.0842
73350NB0514	1240	92.7	1150	34	0.00624	0.942	27	0.00206	0.343	2.58e-05	0.00564	0.0842

Mix designs: 36 to 40 MPa

Table 18: **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	49.2	0.0883	410	1.23e-05	0.536	0.000961	1100
Maximum	515	0.563	571	5.01e-05	12.2	0.00188	3800
Mean	337	0.379	489	2.64e-05	7.78	0.00146	2130
Median	446	0.486	485	1.67e-05	10.6	0.00155	1500
04360ND2010	446	0.486	410	1.23e-05	10.6	0.00155	1100
13400NB1212	515	0.563	485	1.67e-05	12.2	0.00188	1500
60400NB2018	49.2	0.0883	571	5.01e-05	0.536	0.000961	3800

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	1250	74.3	1170	33.8	0.00106	0.792	32.7	0.00235	0.228	2.58e-05	0.00564	0.0842
Maximum	4140	95.3	4090	101	0.00675	7.13	72.8	0.00545	0.259	2.58e-05	0.00564	0.0842

Mean	2370	83.2	2290	60.1	0.00452	4.62	50.1	0.00366	0.248	2.58e-05	0.00564	0.0842
Median	1710	80	1610	45.4	0.00576	5.93	44.8	0.00319	0.258	2.58e-05	0.00564	0.0842
04360ND2010	1250	80	1170	33.8	0.00576	0.792	32.7	0.00235	0.258	2.58e-05	0.00564	0.0842
13400NB1212	1710	95.3	1610	45.4	0.00675	7.13	44.8	0.00319	0.259	2.58e-05	0.00564	0.0842
60400NB2018	4140	74.3	4090	101	0.00106	5.93	72.8	0.00545	0.228	2.58e-05	0.00564	0.0842

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**

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**
13450ND2012	573	0.624	526	1.57e-05	13.6	0.00201	1430

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**
13450ND2012	1650	101	1530	43.9	0.00753	3.95	42	0.00298	0.253	2.58e-05	0.00564	0.0842

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**
13500NB2018	656	0.713	596	1.63e-05	15.6	0.00225	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
13500NB2018	1730	114	1620	46.7	0.00832	3.94	43.5	0.00308	0.273	2.58e-05	0.00564	0.0842

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
13550NB1212	675	0.734	619	1.79e-05	16	0.00236	1670

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
13550NB1212	1910	120	1790	51.3	0.00848	6.26	47.6	0.00338	0.264	2.58e-05	0.00564	0.0842

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
13600NB2012	729	0.791	659	1.72e-05	17.3	0.00249	1630
60600NB1224	61	0.107	769	6.08e-05	0.642	0.0011	4720

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
13600NB2012	1880	127	1750	50.5	0.00939	3.79	45.7	0.00323	0.249	2.58e-05	0.00564	0.0842
60600NB1224	5150	94.4	5090	124	0.00119	6.48	72.2	0.00564	0.227	2.58e-05	0.00564	0.0842

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.