Environmental Product Declaration

Environmental Product Declaration for various ready mix concrete products produced by Holcim México Operaciones S.A. de C.V. at their Hermosillo 1 facility in Sonora

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:	24 July 2023
Period of Validity:	5 years; valid until 23 July 2028
EPD Number:	09234802-d627-4599-ad9e-5434efa7db76

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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 51 concrete mixes manufactured at the Holcim Mexico Operaciones S.A. de C.V. Hermosillo 1 concrete facility in Sonora, 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
3	24015ND0518	2.64 MPa 28d strength mortars and fillers	Mortars and fillers	2.64	2.1343284
4	24025ND0518	2.76 MPa 28d strength mortars and fillers	Mortars and fillers	2.76	2.1304348
5	77035NB2014	3.9 MPa 28d strength Ready mix concrete	Ready mix concrete	3.90	0.7524430
6	60035NB2018	3.62 MPa 28d strength special concrete	Special concrete	3.62	0.6902655
7	24035ND0518	4.36 MPa 28d strength mortars and fillers	Mortars and fillers	4.36	1.6923077
8	77036ND4014	3.78 MPa 28d strength Ready mix concrete	Ready mix concrete	3.78	0.7606557
9	77038ND2014	3.96 MPa 28d strength Ready mix concrete	Ready mix concrete	3.96	0.7084639
10	68038ND4010	3.97 MPa 28d strength special concrete	Special concrete	3.97	0.7160121
11	77040ND2010	4.34 MPa 28d strength Ready mix concrete	Ready mix concrete	4.34	0.6851852
12	68040ND4010	4.38 MPa 28d strength special concrete	Special concrete	4.38	0.6916427

13	77042ND2014	4.41 MPa 28d strength Ready mix concrete	Ready mix concrete	4.41	0.6457143
14	68042ND4010	4.41 MPa 28d strength special concrete	Special concrete	4.41	0.6520548
15	77045ND4014	4.61 MPa 28d strength Ready mix concrete	Ready mix concrete	4.61	0.5959079
16	68045ND4010	4.85 MPa 28d strength special concrete	Special concrete	4.85	0.6218905
17	77048ND4014	5.15 MPa 28d strength Ready mix concrete	Ready mix concrete	5.15	0.5636364
18	68048ND4010	5.3 MPa 28d strength special concrete	Special concrete	5.30	0.5659955
19	76050NB1018	5.1 MPa 28d strength special concrete	Special concrete	5.10	0.8135593
20	24050ND0518	5.19 MPa 28d strength mortars and fillers	Mortars and fillers	5.19	1.4900000
21	11060NB0518	5.98 MPa 28d strength mortars and fillers	Mortars and fillers	5.98	1.2155963
22	70100NB4014	11.47 MPa 28d strength Ready mix concrete	Ready mix concrete	11.47	1.1621622
24	73100NB0514	13.33 MPa 28d strength mortars and fillers	Mortars and fillers	13.33	1.1254753

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
23	40100NB1014	16.27 MPa 28d strength special concrete	Special concrete	16.27	0.8814103
25	71150ND1214	16.86 MPa 28d strength Ready mix concrete	Ready mix concrete	16.86	1.0081967
26	60150ND2012	18.14 MPa 28d strength special concrete	Special concrete	18.14	1.0343348
27	73150NB0518	16.96 MPa 28d strength mortars and fillers	Mortars and fillers	16.96	0.9629630
28	70175ND4010	19.12 MPa 28d strength Ready mix concrete	Ready mix concrete	19.12	0.9566929

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
29	70180ND2010	20.59 MPa 28d strength Ready mix concrete	Ready mix concrete	20.59	1.0133333

30	60180ND2012	21.08 MPa 28d strength special concrete	Special concrete	21.08	0.9956897
31	01200NB2014	24.41 MPa 28d strength Ready mix concrete	Ready mix concrete	24.41	0.9407407
32	60200ND2012	22.26 MPa 28d strength special concrete	Special concrete	22.26	0.9338843
33	73200NB0518	24.32 MPa 28d strength mortars and fillers	Mortars and fillers	24.32	0.8722222
34	70210ND2014	23.04 MPa 28d strength Ready mix concrete	Ready mix concrete	23.04	0.9018868

Mix designs: 26 to 30 MPa

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

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
35	70250NB2018	26.57 MPa 28d strength Ready mix concrete	Ready mix concrete	26.57	0.8175676
36	60250ND4012	27.06 MPa 28d strength special concrete	Special concrete	27.06	0.7417417
37	73250NB0518	28.24 MPa 28d strength mortars and fillers	Mortars and fillers	28.24	0.8005051
38	70280Nb2014	27.85 MPa 28d strength Ready mix concrete	Ready mix concrete	27.85	0.7515337

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
39	70300ND4010	33.34 MPa 28d strength Ready mix concrete	Ready mix concrete	33.34	0.6752137
40	60300ND2012	32.95 MPa 28d strength special concrete	Special concrete	32.95	0.7165605
41	73300NB0514	34.71 MPa 28d strength mortars and fillers	Mortars and fillers	34.71	0.7347932

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
42	70320ND2010	35.89 MPa 28d strength Ready mix concrete	Ready mix concrete	35.89	0.6535211

43	70350NB2018	38.04 MPa 28d strength Ready mix concrete	Ready mix concrete	38.04	0.6051402

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
1	19.45NB2014	42.26 MPa 28d strength Ready mix concrete	Ready mix concrete	42.26	0.4813360
44	40350NB1014	40.2 MPa 28d strength special concrete	Special concrete	40.20	0.5955556
45	73350NB0514	40.4 MPa 28d strength mortars and fillers	Mortars and fillers	40.40	0.6630670
46	70360ND2014	41.38 MPa 28d strength Ready mix concrete	Ready mix concrete	41.38	0.5817757
48	60400NB2014	44.6 MPa 28d strength special concrete	Special concrete	44.6	0.5380952

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
47	70400NB2014	45.11 MPa 28d strength Ready mix concrete	Ready mix concrete	45.11	0.5466667

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
2	60.53NB2014	52.36 MPa 28d strength special concrete	Special concrete	52.36	0.5779817
49	13450NB2014	52.85 MPa 28d strength Ready mix concrete	Ready mix concrete	52.85	0.4969697

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
51	13550NB2018	56.97 MPa 28d strength Ready mix concrete	Ready mix concrete	56.97	0.4147465

Mix designs: >60 MPa

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

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
50	13500NB2018	63.25 MPa 28d strength Ready mix concrete	Ready mix concrete	63.25	0.4604569

READY MIX CONCRETE DESIGN COMPOSITION

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

Table 12: **Design Composition**

Product Components	Raw Material, weight%
Cement	Proprietary
Aggregates	30-60.00
Others	0.01-5.00
Total	100.00

SYSTEM BOUNDARIES

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

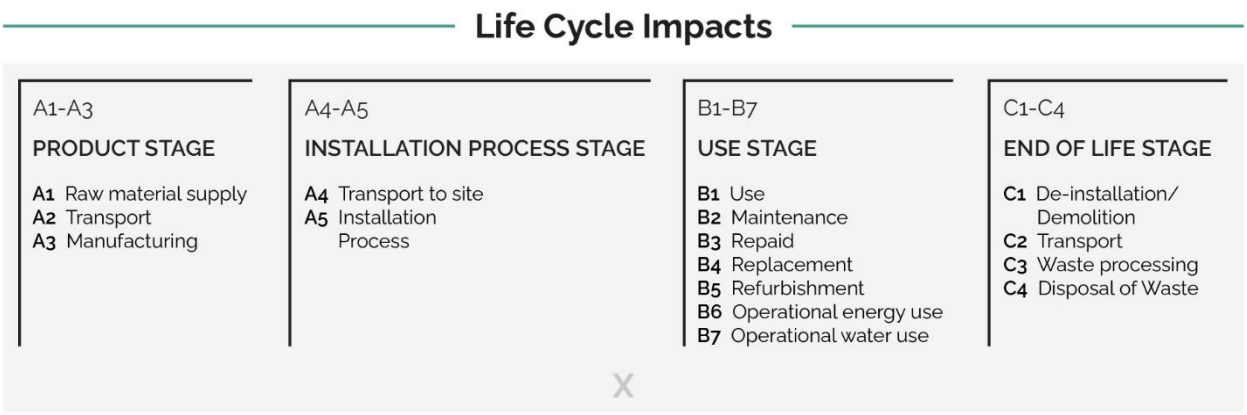

Figure 1: **General life cycle phases for consideration in a construction works system**

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

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

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

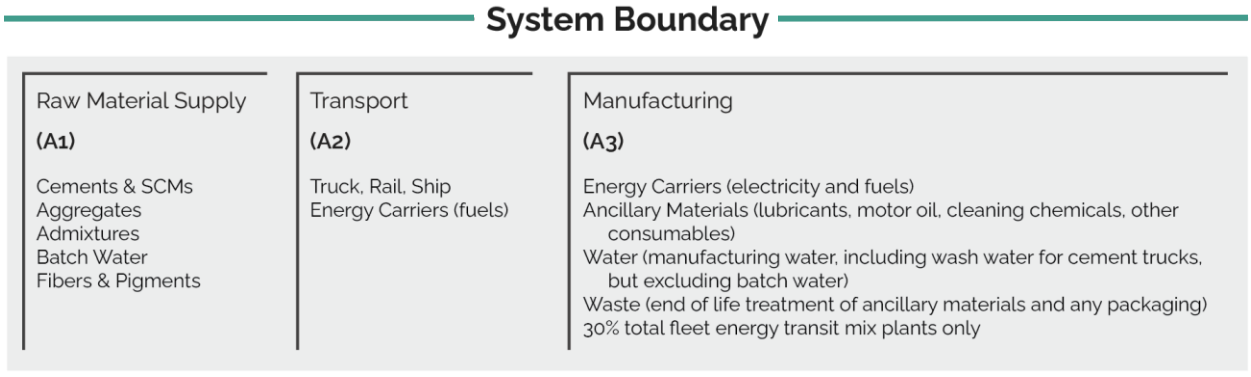

Figure 2: **General system inputs considered in the product system and categorized by modules in scope**

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

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

- Energy use related to company management and sales activities.

For this LCA the manufacturing plant, owned and operated by Holcim México Operaciones S.A. de C.V., is located at their Planta Hermosillo 1 facility in México. All operating data is formulated using the actual data from Holcim México Operaciones S.A. de C.V.'s plant at the above location, including water, energy consumption and waste generation. All inputs for this system boundary are calculated for the plant.

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

CUT-OFF CRITERIA

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

DATA SOURCES AND DATA QUALITY ASSESSMENT

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

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

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

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

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

Recovered energy: Not applicable.

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

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

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

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

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

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

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

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Water	tap water production, conventional with biological treatment/tap water/RoW/kg	ecoinvent v3.8	Sonora	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	Sonora	v3.8 in 2021	2	3	1	3	3
Additives	market for chemical, organic/chemical, organic/GLO/kg	ecoinvent v3.8	Sinaloa	v3.8 in 2021	2	3	1	3	3
Cement (CPC 40) - SUPPLIER:	CPC 40	Progam Operator: Labeling	Sonora	28 March 2023	3	NA	3	3	3

AHR0 Hermosillo - Cement Plant		Sustainability- EPD ID: 30af63b7-21b3-4892-8cda-fa4df53f61d5							
Natural River sand	sand quarry operation, extraction from river bed/sand/BR/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	Sonora	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.

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

LIMITATIONS

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

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

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

TOTAL IMPACT SUMMARY

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

Mix designs: 0 to 15 MPa

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

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	23.4	0.167	192	1.28e-05	0.368	0.000235	987
Maximum	63.3	0.225	497	3.51e-05	0.945	0.000711	2750
Mean	44.8	0.2	355	2.47e-05	0.677	0.000493	1930
Median	47.6	0.202	373	2.61e-05	0.718	0.000531	2050
24015ND0518	23.4	0.167	192	1.28e-05	0.368	0.000235	987
24025ND0518	24	0.17	197	1.31e-05	0.376	0.000242	1010
77035NB2014	46.2	0.202	363	2.53e-05	0.697	0.000515	1990
60035NB2018	49.8	0.208	393	2.74e-05	0.751	0.000548	2130
24035ND0518	27.8	0.176	228	1.53e-05	0.433	0.000287	1190
77036ND4014	45.9	0.202	361	2.51e-05	0.694	0.000508	1970
77038ND2014	47.7	0.205	375	2.61e-05	0.719	0.000531	2050
68038ND4010	49	0.206	386	2.69e-05	0.739	0.000542	2100
77040ND2010	48.3	0.205	379	2.64e-05	0.729	0.000539	2080
68040ND4010	51	0.209	402	2.81e-05	0.768	0.000569	2200
77042ND2014	51.5	0.21	404	2.83e-05	0.775	0.000575	2220
68042ND4010	53.2	0.213	419	2.93e-05	0.8	0.000593	2300
77045ND4014	56.5	0.217	444	3.11e-05	0.847	0.000628	2430
68045ND4010	57.8	0.219	455	3.2e-05	0.867	0.000648	2510
77048ND4014	62.4	0.226	491	3.46e-05	0.934	0.000696	2700
68048ND4010	63.3	0.225	497	3.51e-05	0.945	0.000711	2750
76050NB1018	42	0.194	347	2.36e-05	0.631	0.000464	1850
24050ND0518	31.8	0.182	259	1.76e-05	0.489	0.000338	1380
11060NB0518	34	0.185	276	1.89e-05	0.523	0.000358	1470
70100NB4014	35.5	0.187	280	1.92e-05	0.544	0.000384	1510
73100NB0514	39.8	0.193	321	2.22e-05	0.606	0.000436	1750

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	1070	24	1050	26.6	0.000202	5.44	92.3	0.00114	0.233	0.000124	0.0187	85.3
Maximum	3000	67.2	2930	73.1	0.000465	13.7	104	0.00224	0.313	0.000124	0.0187	85.3
Mean	2110	46.9	2060	51.6	0.000345	8.55	98.4	0.00173	0.265	0.000124	0.0187	85.3
Median	2250	49.8	2190	54.6	0.000364	6.75	99.4	0.0018	0.252	0.000124	0.0187	85.3
24015ND0518	1080	23.8	1050	26.6	0.000202	13.7	94.3	0.00114	0.3	0.000124	0.0187	85.3
24025ND0518	1110	24.6	1080	27.1	0.000207	13.7	92.5	0.00115	0.309	0.000124	0.0187	85.3
77035NB2014	2170	47.9	2120	53	0.000361	6.78	99	0.00175	0.243	0.000124	0.0187	85.3
60035NB2018	2310	51.5	2270	56.6	0.00037	6.57	99.8	0.00185	0.246	0.000124	0.0187	85.3
24035ND0518	1290	28.8	1260	31.8	0.000234	13.5	93.5	0.00126	0.3	0.000124	0.0187	85.3
77036ND4014	2150	47.8	2100	52.4	0.000358	7.39	98.9	0.00176	0.244	0.000124	0.0187	85.3
77038ND2014	2250	49.9	2190	54.6	0.000364	6.47	99.4	0.0018	0.249	0.000124	0.0187	85.3
68038ND4010	2290	51.5	2230	56.3	0.000373	6.96	99.6	0.00184	0.249	0.000124	0.0187	85.3
77040ND2010	2270	50	2210	54.9	0.000369	5.75	99.5	0.00181	0.233	0.000124	0.0187	85.3
68040ND4010	2400	53.5	2340	58.6	0.000385	6.61	100	0.0019	0.252	0.000124	0.0187	85.3
77042ND2014	2400	53.9	2370	58.8	0.000392	5.8	100	0.0019	0.237	0.000124	0.0187	85.3
68042ND4010	2510	55.9	2450	61.4	0.000396	6.21	101	0.00195	0.25	0.000124	0.0187	85.3
77045ND4014	2660	58.7	2600	64.6	0.000415	5.95	102	0.00204	0.245	0.000124	0.0187	85.3
68045ND4010	2740	60.9	2670	66.7	0.000429	5.89	102	0.00208	0.262	0.000124	0.0187	85.3
77048ND4014	2950	66.2	2890	72	0.000457	5.53	103	0.00221	0.26	0.000124	0.0187	85.3
68048ND4010	3000	66.5	2920	73.1	0.000465	5.44	104	0.00224	0.266	0.000124	0.0187	85.3
76050NB1018	2020	45.4	1980	49.5	0.00032	8.69	97	0.00159	0.252	0.000124	0.0187	85.3
24050ND0518	1500	33.6	1470	37	0.000265	13.2	94.7	0.00139	0.313	0.000124	0.0187	85.3

11060NB0518	1610	35.9	1570	39.3	0.000274	13.4	95.3	0.00145	0.278	0.000124	0.0187	85.3
70100NB4014	1640	36.6	1610	40.3	0.000285	9.18	96	0.00147	0.271	0.000124	0.0187	85.3
73100NB0514	1900	42.4	1870	47	0.000325	13	97	0.00162	0.311	0.000124	0.0187	85.3

Mix designs: 15 to 20 MPa

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

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	37	0.189	290	2.01e-05	0.566	0.000403	1570
Maximum	47.3	0.204	379	2.65e-05	0.714	0.000527	2100
Mean	41.7	0.196	330	2.29e-05	0.634	0.00046	1800
Median	39.5	0.193	310	2.15e-05	0.603	0.000431	1680
40100NB1014	46.4	0.203	368	2.57e-05	0.702	0.000515	2030
71150ND1214	38.4	0.191	301	2.08e-05	0.585	0.000424	1640
60150ND2012	37	0.189	290	2.01e-05	0.566	0.000403	1570
73150NB0518	47.3	0.204	379	2.65e-05	0.714	0.000527	2100
70175ND4010	39.5	0.193	310	2.15e-05	0.603	0.000431	1680

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	1710	37.8	1680	41.9	0.000299	7.54	96.4	0.00151	0.253	0.000124	0.0187	85.3
Maximum	2290	51.2	2250	56	0.00038	12.2	99	0.00183	0.328	0.000124	0.0187	85.3
Mean	1970	43.6	1920	48.1	0.000334	9.32	97.7	0.00165	0.277	0.000124	0.0187	85.3
Median	1830	40.5	1790	44.5	0.000314	8.66	97.1	0.00165	0.258	0.000124	0.0187	85.3
40100NB1014	2220	49.2	2170	54.1	0.000369	10.2	99	0.0018	0.289	0.000124	0.0187	85.3
71150ND1214	1780	39.4	1750	43.5	0.000312	7.54	96.8	0.00154	0.258	0.000124	0.0187	85.3
60150ND2012	1710	38.1	1680	41.9	0.000299	8.62	96.4	0.00151	0.253	0.000124	0.0187	85.3
73150NB0518	2290	51.2	2250	56	0.00038	12.2	99.1	0.00183	0.328	0.000124	0.0187	85.3

70175ND4010	1830	40.6	1790	44.8	0.000311	8.03	97.1	0.00158	0.255	0.000124	0.0187	85.3

Mix designs: 21 to 25 MPa

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

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	36	0.188	282	1.94e-05	0.551	0.000388	1510
Maximum	52.1	0.211	415	2.92e-05	0.785	0.000581	2310
Mean	40.9	0.195	322	2.23e-05	0.622	0.000448	1750
Median	39.4	0.193	310	2.14e-05	0.601	0.000432	1680
70180ND2010	36	0.188	282	1.94e-05	0.551	0.000388	1510
60180ND2012	36.8	0.189	289	1.99e-05	0.563	0.000399	1550
01200NB2014	41.4	0.196	326	2.26e-05	0.629	0.000457	1780
60200ND2012	38.1	0.191	298	2.06e-05	0.582	0.000415	1610
73200NB0518	52.1	0.211	415	2.92e-05	0.785	0.000581	2310
70210ND2014	40.8	0.195	321	2.22e-05	0.62	0.000449	1740

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	1650	36.5	1610	40.3	0.000289	7.27	96.1	0.00148	0.237	0.000124	0.0187	85.3
Maximum	2530	56.2	2470	62.1	0.000417	12.8	100	0.00199	0.33	0.000124	0.0187	85.3
Mean	1910	42.4	1860	46.7	0.000324	8.73	97.4	0.00162	0.261	0.000124	0.0187	85.3
Median	1820	40.7	1780	44.6	0.000309	8.14	97.1	0.00157	0.247	0.000124	0.0187	85.3
70180ND2010	1650	36.5	1610	40.3	0.000289	8.29	96.1	0.00148	0.239	0.000124	0.0187	85.3
60180ND2012	1690	37.5	16500	41.4	0.000293	8.23	96.3	0.0015	0.243	0.000124	0.0187	85.3
01200NB2014	1930	42.9	1890	47.2	0.000329	8.05	97.6	0.00163	0.267	0.000124	0.0187	85.3
60200ND2012	1750	39.1	1710	43	3e-04	7.75	96.7	0.00154	0.237	0.000124	0.0187	85.3
73200NB0518	2530	56.2	2470	62.1	0.000417	12.8	100	0.00199	0.33	0.000124	0.0187	85.3

70210ND2014	1890	42.2	1860	46.3	0.000318	7.27	97.4	0.0016	0.251	0.000124	0.0187	85.3

Mix designs: 26 to 30 MPa

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

a) Midpoint Impact Categories:

Indicator/LCI Metric	**AP**	**EP**	**GWP**	**ODP**	**PCOP**	**ADPe**	**ADPf**
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	44.6	0.198	351	2.44e-05	0.675	0.000494	1920
Maximum	56.2	0.217	449	3.16e-05	0.843	0.000633	2500
Mean	49.6	0.206	392	2.74e-05	0.748	0.000552	2160
Median	48.8	0.204	384	2.68e-05	0.738	0.00054	2100
70250NB2018	44.6	0.198	351	2.44e-05	0.675	0.000494	1920
60250ND4012	49.3	0.207	387	2.71e-05	0.745	0.000543	2110
73250NB0518	56.1	0.217	449	3.16e-05	0.843	0.000633	2500
70280NB2014	48.3	0.206	380	2.66e-05	0.73	0.000538	2090

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	2090	46.1	2060	51	0.000345	7.1	98.5	0.00172	0.254	0.000124	0.0187	85.3
Maximum	2750	60.7	2670	66.9	0.000441	11.7	102	0.00209	0.333	0.000124	0.0187	85.3
Mean	2360	52.2	2300	57.4	0.000381	8.36	99.9	0.00187	0.276	0.000124	0.0187	85.3
Median	2300	50.9	2240	55.8	0.000369	7.32	99.6	0.00184	0.258	0.000124	0.0187	85.3
70250NB2018	2090	46.1	2060	51	0.000345	7.41	98.5	0.00172	0.254	0.000124	0.0187	85.3
60250ND4012	2310	51.2	2250	56.1	0.000368	7.24	99.7	0.00185	0.259	0.000124	0.0187	85.3
73250NB0518	2750	60.7	2670	66.9	0.000441	11.7	102	0.00209	0.333	0.000124	0.0187	85.3
70280NB2014	2280	50.6	2220	55.6	0.00037	7.1	99.5	0.00182	0.257	0.000124	0.0187	85.3

Mix designs: 31 to 35 MPa

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

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	47.1	0.204	369	2.58e-05	0.712	0.000523	2020
Maximum	57.9	0.219	463	3.26e-05	0.869	0.000643	2560
Mean	52.2	0.211	412	2.89e-05	0.786	0.000579	2270
Median	51.6	0.21	405	2.84e-05	0.777	0.000572	2220
70300ND4010	51.6	0.21	405	2.84e-05	0.777	0.000572	2220
60300ND2012	47.1	0.204	369	2.58e-05	0.712	0.000523	2020
73300NB0514	57.9	0.219	463	3.26e-05	0.869	0.000643	2560

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	2210	48.8	2160	53.8	0.000336	7.01	101	0.00179	0.236	0.000124	0.0187	85.3
Maximum	2810	62.5	2730	68.5	0.000435	11.9	104	0.00213	0.317	0.000124	0.0187	85.3
Mean	2480	55.3	2420	60.5	0.000395	8.68	102	0.00195	0.267	0.000124	0.0187	85.3
Median	2420	54.5	2380	59.1	0.000391	7.13	102	0.00192	0.249	0.000124	0.0187	85.3
70300ND4010	2420	54.5	2380	59.1	0.000391	7.01	102	0.00192	0.249	0.000124	0.0187	85.3
60300ND2012	2210	48.8	2160	53.8	0.000336	7.13	101	0.00179	0.236	0.000124	0.0187	85.3
73300NB0514	2810	62.5	2730	68.5	0.000435	11.9	104	0.00213	0.317	0.000124	0.0187	85.3

Mix designs: 36 to 40 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
Minimum	52	0.211	408	2.86e-05	0.783	0.00058	2240
Maximum	60.9	0.224	479	3.38e-05	0.91	0.000684	2650
Mean	56.4	0.218	444	3.12e-05	0.846	0.000632	2440
Median	56.4	0.218	444	3.12e-05	0.846	0.000632	2440
70320ND2010	52	0.211	408	2.86e-05	0.783	0.00058	2240
70350NB2018	60.9	0.224	479	3.38e-05	0.91	0.000684	2650

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	2440	54.8	2400	60	0.000393	6.14	102	0.00192	0.244	0.000124	0.0187	85.3
Maximum	2890	65	2830	70.7	0.000447	6.48	105	0.00217	0.272	0.000124	0.0187	85.3
Mean	2660	59.9	2620	65.4	0.00042	6.31	104	0.00204	0.258	0.000124	0.0187	85.3
Median	2660	59.9	2620	65.4	0.00042	6.31	104	0.00204	0.258	0.000124	0.0187	85.3
70320ND2010	2440	54.8	2400	59.6	0.000393	6.48	102	0.00192	0.244	0.000124	0.0187	85.3
70350NB2018	2890	65	2830	70.7	0.000447	6.14	105	0.00217	0.272	0.000124	0.0187	85.3

Mix designs: 41 to 45 MPa

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

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	60.1	0.222	472	3.33e-05	0.901	0.000674	2610
Maximum	70.9	0.238	558	3.95e-05	1.06	0.000795	3090
Mean	63.9	0.228	505	3.57e-05	0.958	0.000718	2800
Median	63.5	0.227	502	3.55e-05	0.951	0.000708	2780
19.45NB2014	70.9	0.238	558	3.95e-05	1.06	0.000795	3090
40350NB1014	63.5	0.227	502	3.55e-05	0.951	0.000708	2780
73350NB0514	64.6	0.229	515	3.65e-05	0.965	0.000729	2880
70360ND2014	60.9	0.224	479	3.38e-05	0.912	0.000685	2650
60400NB2014	60.1	0.222	472	3.33e-05	0.901	0.000674	2610

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	2860	63.4	2780	69.3	0.000445	5.64	103	0.00216	0.237	0.000124	0.0187	85.3
Maximum	3380	75.9	3300	82.3	0.000513	11.5	105	0.00245	0.322	0.000124	0.0187	85.3
Mean	3070	68.5	2990	74.8	0.000474	7.77	104	0.00228	0.272	0.000124	0.0187	85.3
Median	3040	68	2980	74.6	0.00047	6.05	104	0.00229	0.261	0.000124	0.0187	85.3
19.45NB2014	3380	75.9	3300	82.3	0.000513	5.81	105	0.00245	0.257	0.000124	0.0187	85.3
40350NB1014	3040	68	2980	74.6	0.00047	9.84	104	0.00229	0.281	0.000124	0.0187	85.3
73350NB0514	3160	70.6	3080	77.1	0.000494	11.5	104	0.00233	0.322	0.000124	0.0187	85.3
70360ND2014	2900	64.4	2830	70.7	0.000445	5.64	103	0.00217	0.261	0.000124	0.0187	85.3
60400NB2014	2860	63.4	2780	69.3	0.000446	6.05	103	0.00216	0.237	0.000124	0.0187	85.3

Mix designs: 46 to 50 MPa

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

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
70400NB2014	63.6	0.227	500	3.53e-05	0.951	0.000714	2770

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
70400NB2014	3030	67.7	2960	74	0.000463	5.95	104	0.00225	0.258	0.000124	0.0187	85.3

Mix designs: 51 to 55 MPa

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

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	61.9	0.225	487	3.44e-05	0.927	0.000694	2690
Maximum	69.7	0.236	547	3.89e-05	1.04	0.000804	3090
Mean	65.8	0.228	517	3.66e-05	0.984	0.000749	2890
Median	65.8	0.228	517	3.66e-05	0.984	0.000749	2890
60.53NB2014	61.9	0.225	487	3.44e-05	0.927	0.000694	2690
13450NB2014	69.7	0.236	547	3.89e-05	1.04	0.000804	3090

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	2940	65.9	2880	71.5	0.00045	5.99	103	0.0022	0.258	0.000124	0.0187	85.3
Maximum	3380	75.3	3300	82.6	0.000536	6	106	0.00245	0.265	0.000124	0.0187	85.3
Mean	3160	70.6	3090	77	0.000493	6	104	0.00232	0.262	0.000124	0.0187	85.3
Median	3160	70.6	3090	77	0.000493	6	104	0.00232	0.262	0.000124	0.0187	85.3
60.53NB2014	2940	65.9	2880	71.5	0.00045	5.99	103	0.0022	0.265	0.000124	0.0187	85.3
13450NB2014	3380	75.3	3300	82.6	0.000536	6	106	0.00245	0.258	0.000124	0.0187	85.3

Mix designs: 56 to 60 MPa

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

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
13550NB2018	88.4	0.263	695	4.96e-05	1.31	0.000998	3880

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
13550NB2018	4270	95.4	4130	103	0.00062	4.61	110	0.00295	0.284	0.000124	0.0187	85.3

Mix designs: >60 MPa

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

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
13500NB2018	78.7	0.249	617	4.4e-05	1.17	0.000898	3470

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	3870	84.2	3720	92.4	0.000577	5.34	108	0.00269	0.275	0.000124	0.0187	85.3

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.