Environmental Product Declaration

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

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:	e64c8e9f-0678-452f-b795-561da2e096d4

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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 50 concrete mixes manufactured at the Holcim Mexico Operaciones S.A. de C.V. Ruiz Cortinez concrete facility in Nuevo Leon, 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
2	68015NB0514	1.47 MPa 28d strength special concrete	special concrete	1.47	1.9247312
3	68025NB0518	2.45 MPa 28d strength special concrete	special concrete	2.45	1.5726496
4	24025NB0518	2.45 MPa 28d strength mortars and fillers	mortars and fillers	2.45	0.4892308
5	39035ND2010	3.43 MPa 28d strength Ready mix concrete	Ready mix concrete	3.43	0.7109005
6	68035ND2010	3.43 MPa 28d strength special concrete	special concrete	3.43	0.6652361
7	39036ND2010	3.53 MPa 28d strength Ready mix concrete	Ready mix concrete	3.53	0.6898148
8	39038ND4012	3.73 MPa 28d strength Ready mix concrete	Ready mix concrete	3.73	0.6846847
9	68038NB2014	3.73 MPa 28d strength special concrete	special concrete	3.73	0.6782609
10	77040ND4014	3.92 MPa 28d strength Ready mix concrete	Ready mix concrete	3.92	0.6528926
11	68040NB2014	3.92 MPa 28d strength special concrete	special concrete	3.92	0.6681034

12	39042ND4010	4.12 MPa 28d strength Ready mix concrete	Ready mix concrete	4.12	0.6097561
13	68042ND4010	4.12 MPa 28d strength special concrete	special concrete	4.12	0.6666667
14	39045ND2010	4.41 MPa 28d strength Ready mix concrete	Ready mix concrete	4.41	0.5916031
15	68045ND4010	4.41 MPa 28d strength special concrete	special concrete	4.41	0.5905512
16	77048NB2014	4.71 MPa 28d strength Ready mix concrete	Ready mix concrete	4.71	0.5445205
17	68048ND2010	4.71 MPa 28d strength special concrete	special concrete	4.71	0.5852713
18	73050ND0518	4.9 MPa 28d strength mortars and fillers	mortars and fillers	4.90	1.4689655
19	68060NB0514	5.88 MPa 28d strength special concrete	special concrete	5.88	1.0114943
20	71100ND1010	9.81 MPa 28d strength Ready mix concrete	Ready mix concrete	9.81	1.0432099
21	68100NB2018	9.81 MPa 28d strength special concrete	special concrete	9.81	0.7073171
22	73100ND0514	9.81 MPa 28d strength mortars and fillers	mortars and fillers	9.81	1.1796407
23	68120NB2018	11.77 MPa 28d strength special concrete	special concrete	11.77	0.5094340
24	70150NB2018	14.71 MPa 28d strength Ready mix concrete	Ready mix concrete	14.71	0.9820359
25	68150NB0514	14.71 MPa 28d strength special concrete	special concrete	14.71	0.8695652
26	73150NB0514	14.71 MPa 28d strength mortars and fillers	mortars and fillers	14.71	0.9556650

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
27	01200ND4014	19.61 MPa 28d strength Ready mix concrete	Ready mix concrete	19.61	0.8608247
28	68200NB0518	19.61 MPa 28d strength special concrete	special concrete	19.61	0.7913386
29	73200NB0514	19.61 MPa 28d strength mortars and fillers	mortars and fillers	19.61	0.7868852

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
31	68250NB1014	24.52 MPa 28d strength special concrete	special concrete	24.52	0.6180556
32	73250NB0514	24.52 MPa 28d strength mortars and fillers	mortars and fillers	24.52	0.6807018

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
33	70280NB2014	27.46 MPa 28d strength Ready mix concrete	Ready mix concrete	27.46	0.5310345
34	01300NB2018	29.42 MPa 28d strength Ready mix concrete	Ready mix concrete	29.42	0.6678832
35	60300NB2022	29.42 MPa 28d strength special concrete	special concrete	29.42	0.6083916
36	73300NB0518	29.42 MPa 28d strength mortars and fillers	mortars and fillers	29.42	0.5121951

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
30	70250NB2014	31.6 MPa 28d strength Ready mix concrete	Ready mix concrete	31.60	0.6936937
37	01350NB2014	34.32 MPa 28d strength Ready mix concrete	Ready mix concrete	34.32	0.5663430
38	60350NB2014	34.32 MPa 28d strength special concrete	special concrete	34.32	0.5728477
39	73350NB0514	34.32 MPa 28d strength mortars and fillers	mortars and fillers	34.32	0.4545455

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
40	13400ND2010	39.23 MPa 28d strength Ready mix concrete	Ready mix concrete	39.23	0.482866

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
42	13450ND2010	44.13 MPa 28d strength Ready mix concrete	Ready mix concrete	44.13	0.4518950
43	60450NB2022	44.13 MPa 28d strength special concrete	special concrete	44.13	0.4104478

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
44	13500ND2010	49.03 MPa 28d strength Ready mix concrete	Ready mix concrete	49.03	0.416

Mix designs: 51 to 55 MPa

Table 8: **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
1	3745NB2014	54 MPa 28d strength Ready mix concrete	Ready mix concrete	54.00	0.4428571
41	60400NB2022	54.9 MPa 28d strength special concrete	special concrete	54.90	0.4202128
46	13550ND2010	53.94 MPa 28d strength Ready mix concrete	Ready mix concrete	53.94	0.3589744
47	60550NB2022	53.94 MPa 28d strength special concrete	special concrete	53.94	0.3507014

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
48	13600NB2014	58.84 MPa 28d strength Ready mix concrete	Ready mix concrete	58.84	0.3265306

Mix designs: >60 MPa

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

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
45	60500NB2022	60.9 MPa 28d strength special concrete	special concrete	60.90	0.4057279
49	14650NB1022	63.74 MPa 28d strength Ready mix concrete	Ready mix concrete	63.74	0.3152866
50	14750NB2022	73.55 MPa 28d strength Ready mix concrete	Ready mix concrete	73.55	0.2843750

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:

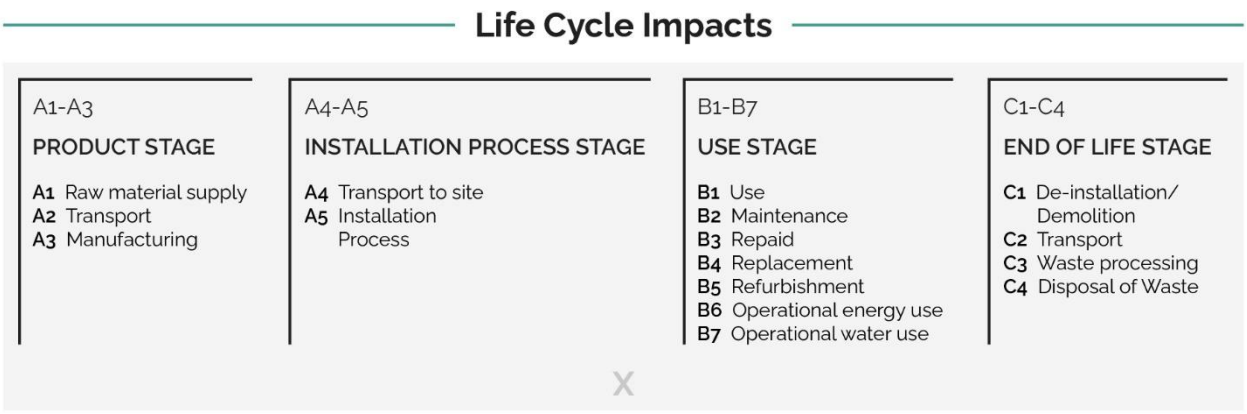

Figure 1: **General life cycle phases for consideration in a construction works system**

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

System Boundary

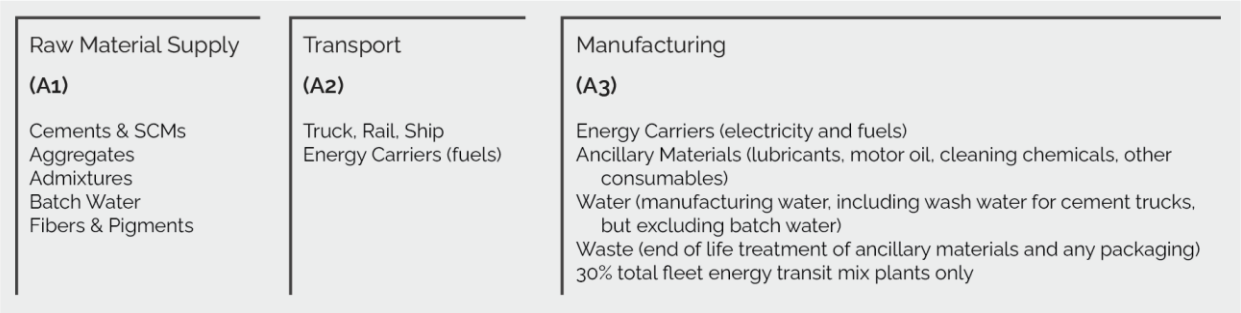

Figure 2: **General system inputs considered in the product system and categorized by modules in scope**

- 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.

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 Ruiz Cortinez 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	Nuevo Leon	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	Nuevo Leon	v3.8 in 2021	2	3	1	3	3
Additives	market for chemical, organic/chemical, organic/GLO/kg	ecoinvent v3.8	Nuevo Leon	v3.8 in 2021	2	3	1	3	3
Cement (CPC 40) - Ramos Azripe	CPC 40	Progam Operator: Labeling Sustainability-EPD ID: ab22ee19-4f97-41a2-bf8a-4297c635a5d6	Coahuila	very good, 3rd party verfied facility-specific EPD dataset	3	NA	3	3	3
Fly Ash	Waste input produced off-site	See A3 inputs	Coahulia	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.

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	32.1	0.355	287	2.74e-05	0.451	0.000647	2090
Maximum	56.2	0.391	503	4.2e-05	0.796	0.00134	3220
Mean	45.1	0.374	401	3.53e-05	0.637	0.00102	2690
Median	46.3	0.376	412	3.57e-05	0.656	0.00105	2730
68015NB0514	32.1	0.355	287	2.74e-05	0.451	0.000647	2090
68025NB0518	34.3	0.358	308	2.87e-05	0.482	0.000713	2190
24025NB0518	56.2	0.391	503	4.2e-05	0.796	0.00134	3220
39035ND2010	45.2	0.375	399	3.54e-05	0.639	0.00101	2690
68035ND2010	46.8	0.376	414	3.57e-05	0.665	0.00105	2730
39036ND2010	45.6	0.375	404	3.57e-05	0.646	0.00102	2720
39038ND4012	46.3	0.376	409	3.61e-05	0.655	0.00105	2760
68038NB2014	47.1	0.378	417	3.66e-05	0.667	0.00107	2800
77040ND4014	47.9	0.379	427	3.71e-05	0.678	0.0011	2830
68040NB2014	47.1	0.378	418	3.66e-05	0.667	0.00106	2770
39042ND4010	48.5	0.38	431	3.74e-05	0.686	0.00111	2860
68042ND4010	46.7	0.377	412	3.63e-05	0.661	0.00106	2780
39045ND2010	50	0.382	445	3.83e-05	0.707	0.00116	2930
68045ND4010	49.1	0.381	437	3.78e-05	0.696	0.00112	2860
77048NB2014	52.6	0.386	472	3.98e-05	0.743	0.00124	3050
68048ND2010	49.8	0.382	442	3.82e-05	0.705	0.00115	2920
73050ND0518	38.6	0.365	340	3.16e-05	0.544	0.000828	2400
68060NB0514	40.2	0.367	363	3.26e-05	0.564	0.000898	2500
71100ND1010	40.2	0.367	352	3.2e-05	0.571	0.000854	2430
68100NB2018	42.8	0.371	390	3.41e-05	0.601	0.000976	2620
73100ND0514	40.8	0.368	360	3.29e-05	0.575	0.000892	2500
68120NB2018	47.5	0.377	437	3.62e-05	0.671	0.00111	2780
70150NB2018	40.9	0.368	359	3.29e-05	0.578	0.000884	2500
68150NB0514	46.3	0.376	412	3.55e-05	0.656	0.00105	2720
73150NB0514	44.1	0.373	392	3.49e-05	0.622	0.000994	2660

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	43.1	2170	55.9	0.0019	0.369	346	0.00476	0.168	4.06e-05	0.0389	187
Maximum	3490	87	3380	87.2	0.00497	0.438	364	0.00595	0.25	4.06e-05	0.0389	187
Mean	2900	66.4	2830	72.7	0.00358	0.398	356	0.00541	0.199	4.06e-05	0.0389	187
Median	2940	68.5	2870	73.8	0.00373	0.393	357	0.00545	0.19	4.06e-05	0.0389	187
68015NB0514	2210	43.1	2170	55.9	0.0019	0.377	346	0.00476	0.214	4.06e-05	0.0389	187

68025NB0518	2340	47.3	2280	58.7	0.00222	0.388	347	0.00483	0.219	4.06e-05	0.0389	187
24025NB0518	3490	87	3380	87.2	0.00497	0.425	364	0.00595	0.193	4.06e-05	0.0389	187
39035ND2010	2900	65.4	2810	72.7	0.00348	0.383	357	0.00545	0.184	4.06e-05	0.0389	187
68035ND2010	2940	69	2860	73.8	0.00378	0.389	354	0.00534	0.189	4.06e-05	0.0389	187
39036ND2010	2930	67.6	2870	73.4	0.00363	0.383	357	0.00548	0.183	4.06e-05	0.0389	187
39038ND4012	2980	69	2890	74.5	0.00373	0.389	358	0.0055	0.186	4.06e-05	0.0389	187
68038NB2014	3010	69.6	2940	75.6	0.00379	0.396	358	0.00555	0.19	4.06e-05	0.0389	187
77040ND4014	3040	71.2	2960	76.8	0.00395	0.4	358	0.00556	0.192	4.06e-05	0.0389	187
68040NB2014	2990	69	2930	74.7	0.00371	0.393	358	0.00554	0.189	4.06e-05	0.0389	187
39042ND4010	3080	73.3	3010	77.8	0.00392	0.393	359	0.00559	0.184	4.06e-05	0.0389	187
68042ND4010	2990	68.5	2890	74.8	0.00378	0.388	358	0.00553	0.184	4.06e-05	0.0389	187
39045ND2010	3190	75.8	3080	79.7	0.00427	0.403	360	0.00565	0.189	4.06e-05	0.0389	187
68045ND4010	3100	73	3010	77.1	0.0042	0.393	360	0.00562	0.184	4.06e-05	0.0389	187
77048NB2014	3290	81.8	3240	82.9	0.00459	0.415	361	0.00575	0.193	4.06e-05	0.0389	187
68048ND2010	3140	74.8	3070	79.2	0.00415	0.398	360	0.00566	0.185	4.06e-05	0.0389	187
73050ND0518	2570	53.9	2520	64.6	0.00268	0.434	353	0.00521	0.25	4.06e-05	0.0389	187
68060NB0514	2690	58.5	2620	67.5	0.00299	0.4	352	0.00519	0.211	4.06e-05	0.0389	187
71100ND1010	2600	56.4	2580	65.1	0.00284	0.387	352	0.00514	0.204	4.06e-05	0.0389	187
68100NB2018	2820	64.5	2730	70.7	0.00353	0.372	353	0.00525	0.178	4.06e-05	0.0389	187
73100ND0514	2690	57.3	2620	67.3	0.00292	0.423	354	0.00531	0.233	4.06e-05	0.0389	187
68120NB2018	3000	73.9	2940	75.6	0.00423	0.369	351	0.00522	0.168	4.06e-05	0.0389	187
70150NB2018	2670	57.6	2630	67	0.00297	0.386	355	0.00528	0.198	4.06e-05	0.0389	187
68150NB0514	2940	67.6	2860	73.4	0.00385	0.438	354	0.00536	0.236	4.06e-05	0.0389	187
73150NB0514	2850	64.1	2770	71.7	0.00342	0.43	356	0.00544	0.23	4.06e-05	0.0389	187

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	43.4	0.372	383	3.44e-05	0.614	0.000957	2610
Maximum	49.3	0.381	439	3.8e-05	0.695	0.00115	2910
Mean	46.9	0.377	417	3.65e-05	0.662	0.00107	2780
Median	47.9	0.379	429	3.72e-05	0.676	0.00111	2830
01200ND4014	43.4	0.372	383	3.44e-05	0.614	0.000957	2610
68200NB0518	49.3	0.381	439	3.8e-05	0.695	0.00115	2910
73200NB0514	47.9	0.379	429	3.72e-05	0.676	0.00111	2830

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	2790	62.7	2750	70.3	0.0033	0.396	356	0.00537	0.202	4.06e-05	0.0389	187
Maximum	3140	74.2	3050	78.8	0.00416	0.453	359	0.00568	0.237	4.06e-05	0.0389	187
Mean	2990	69.5	2930	75.3	0.00379	0.429	358	0.00555	0.222	4.06e-05	0.0389	187
Median	3040	71.7	2980	76.8	0.00392	0.438	358	0.00561	0.228	4.06e-05	0.0389	187
01200ND4014	2790	62.7	2750	70.3	0.0033	0.396	356	0.00537	0.202	4.06e-05	0.0389	187
68200NB0518	3140	74.2	3050	78.8	0.00416	0.453	359	0.00568	0.237	4.06e-05	0.0389	187
73200NB0514	3040	71.7	2980	76.8	0.00392	0.438	358	0.00561	0.228	4.06e-05	0.0389	187

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	50.5	0.382	458	3.79e-05	0.716	0.00118	2900
Maximum	51.4	0.383	462	3.83e-05	0.731	0.00119	2940
Mean	51	0.382	460	3.81e-05	0.724	0.00119	2920
Median	51	0.382	460	3.81e-05	0.724	0.00119	2920
68250NB1014	51.4	0.383	462	3.83e-05	0.731	0.00119	2940
73250NB0514	50.5	0.382	458	3.79e-05	0.716	0.00118	2900

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	3140	78.6	3040	78.8	0.00443	0.426	355	0.00545	0.213	4.06e-05	0.0389	187
Maximum	3180	79.5	3110	79.3	0.00456	0.442	356	0.00548	0.23	4.06e-05	0.0389	187
Mean	3160	79	3080	79	0.0045	0.434	356	0.00546	0.222	4.06e-05	0.0389	187
Median	3160	79	3080	79	0.0045	0.434	356	0.00546	0.222	4.06e-05	0.0389	187
68250NB1014	3180	79.5	3110	79.3	0.00456	0.426	356	0.00548	0.213	4.06e-05	0.0389	187
73250NB0514	3140	78.6	3040	78.8	0.00443	0.442	355	0.00545	0.23	4.06e-05	0.0389	187

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	50.7	0.383	455	3.82e-05	0.717	0.00118	2920

Maximum	62.3	0.399	569	4.45e-05	0.884	0.00153	3440
Mean	53.9	0.387	487	3.99e-05	0.766	0.00127	3060
Median	51.4	0.383	462	3.86e-05	0.731	0.00119	2940
70280NB2014	51.6	0.383	463	3.84e-05	0.735	0.00119	2940
01300NB2018	50.7	0.383	455	3.87e-05	0.717	0.00118	2950
60300NB2022	51.1	0.383	460	3.82e-05	0.727	0.00118	2920
73300NB0518	62.3	0.399	569	4.45e-05	0.884	0.00153	3440

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	3150	77.7	3080	79.3	0.00432	0.4	355	0.00546	0.188	4.06e-05	0.0389	187
Maximum	3730	99.9	3640	94.4	0.00627	0.492	360	0.00586	0.247	4.06e-05	0.0389	187
Mean	3310	83.6	3230	83.3	0.00491	0.436	358	0.00562	0.216	4.06e-05	0.0389	187
Median	3180	78.4	3100	79.8	0.00452	0.427	358	0.00558	0.214	4.06e-05	0.0389	187
70280NB2014	3180	79.1	3080	79.4	0.00451	0.4	356	0.00549	0.188	4.06e-05	0.0389	187
01300NB2018	3190	77.7	3110	80.1	0.00432	0.434	360	0.00567	0.218	4.06e-05	0.0389	187
60300NB2022	3150	77.7	3080	79.3	0.00454	0.42	355	0.00546	0.209	4.06e-05	0.0389	187
73300NB0518	3730	99.9	3640	94.4	0.00627	0.492	359	0.00586	0.247	4.06e-05	0.0389	187

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	45.9	0.376	408	3.59e-05	0.65	0.00103	2730
Maximum	65.1	0.403	596	4.6e-05	0.923	0.00161	3560
Mean	54.7	0.388	493	4.08e-05	0.774	0.0013	3120
Median	53.8	0.388	484	4.06e-05	0.762	0.00128	3100
70250NB2014	45.9	0.376	408	3.59e-05	0.65	0.00103	2730
70250NB2014	45.9	0.376	408	3.59e-05	0.65	0.00103	2730
60350NB2014	53.7	0.387	481	4.05e-05	0.759	0.00127	3100

73350NB0514	65.1	0.403	596	4.6e-05	0.923	0.00161	3560

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	2970	68.2	2850	73.7	0.00356	0.389	357	0.00548	0.188	4.06e-05	0.0389	187
Maximum	3860	105	3750	97.4	0.00654	0.488	362	0.00596	0.236	4.06e-05	0.0389	187
Mean	3380	84.8	3290	84.8	0.00494	0.436	360	0.00576	0.21	4.06e-05	0.0389	187
Median	3360	83	3280	84	0.00483	0.434	361	0.00581	0.209	4.06e-05	0.0389	187
70250NB2014	2970	68.2	2850	73.7	0.00356	0.389	357	0.00548	0.188	4.06e-05	0.0389	187
70250NB2014	3370	84.4	3280	84.1	0.00476	0.435	362	0.00581	0.21	4.06e-05	0.0389	187
60350NB2014	3340	81.6	3280	84	0.0049	0.433	362	0.00581	0.208	4.06e-05	0.0389	187
73350NB0514	3860	105	3750	97.4	0.00654	0.488	360	0.00596	0.236	4.06e-05	0.0389	187

Mix designs: 36 to 40 MPa

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

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	55.1	0.389	497	4.14e-05	0.78	0.00131	3160
Maximum	55.1	0.389	497	4.14e-05	0.78	0.00131	3160
Mean	55.1	0.389	497	4.14e-05	0.78	0.00131	3160
Median	55.1	0.389	497	4.14e-05	0.78	0.00131	3160
13400ND2010	55.1	0.389	497	4.14e-05	0.78	0.00131	3160

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	3400	86.4	3320	85.6	0.00493	0.416	363	0.00586	0.189	4.06e-05	0.0389	187
Maximum	3400	86.4	3320	85.6	0.00493	0.416	363	0.00586	0.189	4.06e-05	0.0389	187
Mean	3400	86.4	3320	85.6	0.00493	0.416	363	0.00586	0.189	4.06e-05	0.0389	187
Median	3400	86.4	3320	85.6	0.00493	0.416	363	0.00586	0.189	4.06e-05	0.0389	187
13400ND2010	3400	86.4	3320	85.6	0.00493	0.416	363	0.00586	0.189	4.06e-05	0.0389	187

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	57.2	0.392	517	4.26e-05	0.809	0.00137	3250
Maximum	62.6	0.401	570	4.59e-05	0.884	0.00154	3510
Mean	59.9	0.396	544	4.42e-05	0.846	0.00146	3380
Median	59.9	0.396	544	4.42e-05	0.846	0.00146	3380
13450ND2010	57.2	0.392	517	4.26e-05	0.809	0.00137	3250
60450NB2022	62.6	0.401	570	4.59e-05	0.884	0.00154	3510

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	3530	91	3440	88.3	0.00509	0.422	364	0.00594	0.189	4.06e-05	0.0389	187
Maximum	3810	101	3710	95.7	0.0061	0.449	367	0.00619	0.2	4.06e-05	0.0389	187
Mean	3670	96	3580	92	0.0056	0.436	366	0.00606	0.194	4.06e-05	0.0389	187

Median	3670	96	3580	92	0.00569	0.436	366	0.00606	0.194	4.06e-05	0.0389	187
13450ND2010	3530	91	3440	88.3	0.00509	0.422	364	0.00594	0.189	4.06e-05	0.0389	187
60450NB2022	3810	101	3710	95.7	0.0061	0.449	367	0.00619	0.2	4.06e-05	0.0389	187

Mix designs: 46 to 50 MPa

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

a) Midpoint Impact Categories:

Indicator/LCI Metric	**AP**	**EP**	**GWP**	**ODP**	**PCOP**	**ADPe**	**ADPf**
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	60.1	0.397	545	4.43e-05	0.851	0.00146	3390
Maximum	60.1	0.397	545	4.43e-05	0.851	0.00146	3390
Mean	60.1	0.397	545	4.43e-05	0.851	0.00146	3390
Median	60.1	0.397	545	4.43e-05	0.851	0.00146	3390
13500ND2010	60.1	0.397	545	4.43e-05	0.851	0.00146	3390

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	3660	96.1	3580	92.5	0.00567	0.432	365	0.00607	0.19	4.06e-05	0.0389	187
Maximum	3660	96.1	3580	92.5	0.00567	0.432	365	0.00607	0.19	4.06e-05	0.0389	187
Mean	3660	96.1	3580	92.5	0.00567	0.432	365	0.00607	0.19	4.06e-05	0.0389	187
Median	3660	96.1	3580	92.5	0.00567	0.432	365	0.00607	0.19	4.06e-05	0.0389	187
13500ND2010	3660	96.1	3580	92.5	0.00567	0.432	365	0.00607	0.19	4.06e-05	0.0389	187

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	57.2	0.392	517	4.16e-05	0.814	0.00136	3190
Maximum	72.1	0.415	660	5.15e-05	1.02	0.00184	3990
Mean	63.7	0.402	580	4.63e-05	0.902	0.00157	3560
Median	62.8	0.401	572	4.6e-05	0.888	0.00154	3520
3745NB2014	57.2	0.392	517	4.16e-05	0.814	0.00136	3190
60400NB2022	60.5	0.398	549	4.48e-05	0.854	0.00148	3430
13550ND2010	65.1	0.404	594	4.73e-05	0.921	0.00161	3620
60550NB2022	72.1	0.415	660	5.15e-05	1.02	0.00184	3990

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	3450	88.6	3360	86.9	0.00526	0.416	358	0.00568	0.188	4.06e-05	0.0389	187
Maximum	4350	118	4230	109	0.00746	0.49	373	0.00662	0.21	4.06e-05	0.0389	187
Mean	3860	103	3760	97	0.0062	0.446	366	0.00618	0.195	4.06e-05	0.0389	187
Median	3820	102	3730	96.2	0.00604	0.44	368	0.00622	0.19	4.06e-05	0.0389	187
3745NB2014	3450	88.6	3360	86.9	0.00526	0.416	358	0.00568	0.189	4.06e-05	0.0389	187
60400NB2022	3720	97.9	3630	93.5	0.00576	0.437	367	0.00616	0.192	4.06e-05	0.0389	187
13550ND2010	3930	106	3830	98.8	0.00632	0.443	368	0.00627	0.188	4.06e-05	0.0389	187
60550NB2022	4350	118	4230	109	0.00746	0.49	373	0.00662	0.21	4.06e-05	0.0389	187

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
Minimum	70.7	0.412	648	5.05e-05	0.999	0.00178	3880
Maximum	70.7	0.412	648	5.05e-05	0.999	0.00178	3880
Mean	70.7	0.412	648	5.05e-05	0.999	0.00178	3880
Median	70.7	0.412	648	5.05e-05	0.999	0.00178	3880
13600NB2014	70.7	0.412	648	5.05e-05	0.999	0.00178	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
Minimum	3660	96.1	3580	92.5	0.00567	0.432	365	0.00607	0.19	4.06e-05	0.0389	187
Maximum	3660	96.1	3580	92.5	0.00567	0.432	365	0.00607	0.19	4.06e-05	0.0389	187
Mean	3660	96.1	3580	92.5	0.00567	0.432	365	0.00607	0.19	4.06e-05	0.0389	187
Median	3660	96.1	3580	92.5	0.00567	0.432	365	0.00607	0.19	4.06e-05	0.0389	187
13600NB2014	3660	96.1	3580	92.5	0.00567	0.432	365	0.00607	0.19	4.06e-05	0.0389	187

Mix designs: >60 MPa

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

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	64.1	0.403	585	4.68e-05	0.905	0.00159	3580
Maximum	84.1	0.431	777	5.71e-05	1.19	0.00219	4490
Mean	76.8	0.42	707	5.31e-05	1.09	0.00197	4140
Median	82.1	0.427	760	5.53e-05	1.17	0.00212	4340

60500NB2022	64.1	0.403	585	4.68e-05	0.905	0.00159	3580
14650NB1022	82.1	0.427	760	5.53e-05	1.17	0.00212	4340
14750NB2022	84.1	0.431	777	5.71e-05	1.19	0.00219	4490

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	3890	105	3790	98.4	0.00636	0.459	366	0.00625	0.205	4.06e-05	0.0389	187
Maximum	4900	141	4750	124	0.00924	0.531	372	0.00674	0.234	4.06e-05	0.0389	187
Mean	4510	129	4380	114	0.00826	0.505	369	0.00648	0.219	4.06e-05	0.0389	187
Median	4730	141	4600	119	0.00919	0.525	368	0.00646	0.217	4.06e-05	0.0389	187
60500NB2022	3890	105	3790	98.4	0.00636	0.459	368	0.00625	0.205	4.06e-05	0.0389	187
14650NB1022	4730	141	4600	119	0.00919	0.531	366	0.00646	0.234	4.06e-05	0.0389	187
14750NB2022	4900	141	4750	124	0.00924	0.525	372	0.00674	0.217	4.06e-05	0.0389	187

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.