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 II 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:	f340c349-d03d-43dc-9150-2db1fc22fa0c

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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 46 concrete mixes manufactured at the Holcim Mexico Operaciones S.A. de C.V. Hermosillo II 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	2.68 MPa 28d strength mortars and fillers	Mortars and fillers	2.68	2.13
4	77035NB4014	3.9 MPa 28d strength Ready mix concrete	Ready mix concrete	3.90	0.73
5	60035NB2018	3.85 MPa 28d strength special concrete	Special concrete	3.85	0.72
6	24035NB0518	5.63 MPa 28d strength mortars and fillers	Mortars and fillers	5.63	1.69
7	77036ND4010	3.79 MPa 28d strength Ready mix concrete	Ready mix concrete	3.79	0.69
8	77038ND4006	3.97 MPa 28d strength Ready mix concrete	Ready mix concrete	3.97	0.69
9	68038ND4010	3.97 MPa 28d strength special concrete	Special concrete	3.97	0.71
10	77040ND4010	4.25 MPa 28d strength Ready mix concrete	Ready mix concrete	4.25	0.67

11	68040ND4010	4.31 MPa 28d strength special concrete	Special concrete	4.31	0.69
12	77042ND2014	4.33 MPa 28d strength Ready mix concrete	Ready mix concrete	4.33	0.65
13	68042ND4010	4.45 MPa 28d strength special concrete	Special concrete	4.45	0.65
14	77045ND4010	4.57 MPa 28d strength Ready mix concrete	Ready mix concrete	4.57	0.57
15	68045ND4010	4.8 MPa 28d strength special concrete	Special concrete	4.80	0.62
16	77048NB4014	4.8 MPa 28d strength Ready mix concrete	Ready mix concrete	4.80	0.56
17	77050ND4010	5.88 MPa 28d strength Ready mix concrete	Ready mix concrete	5.88	0.46
18	76050NB1018	5.59 MPa 28d strength special concrete	Special concrete	5.59	1.02
19	11050NB0514	5.4 MPa 28d strength mortars and fillers	Mortars and fillers	5.40	1.31
20	70100NB2014	11.46 MPa 28d strength Ready mix concrete	Ready mix concrete	11.46	1.26
21	11100NB0524	11.43 MPa 28d strength mortars and fillers	Mortars and fillers	11.43	10.39

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
22	70150NB2018	17.66 MPa 28d strength Ready mix concrete	Ready mix concrete	17.66	1.05
23	60150ND2012	18.9 MPa 28d strength special concrete	Special concrete	18.90	0.98
24	73150NB0514	17 MPa 28d strength mortars and fillers	Mortars and fillers	17.00	0.81
25	70175ND2014	19.13 MPa 28d strength Ready mix concrete	Ready mix concrete	19.13	1.00

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
26	70200NB2016	21.98 MPa 28d strength Ready mix concrete	Ready mix concrete	21.98	0.91
27	60200ND2012	23.74 MPa 28d strength special concrete	Special concrete	23.74	0.85

28	73200NB0514	22.1 MPa 28d strength mortars and fillers	Mortars and fillers	22.10	0.73
29	70210ND4010	22.9 MPa 28d strength Ready mix concrete	Ready mix concrete	22.90	0.87

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
30	70250ND2010	27.67 MPa 28d strength Ready mix concrete	Ready mix concrete	27.67	0.80
31	60250ND4012	27.88 MPa 28d strength special concrete	Special concrete	27.88	0.90
32	73250NB0514	26.45 MPa 28d strength mortars and fillers	Mortars and fillers	26.45	0.66
33	70280ND2006	27.87 MPa 28d strength Ready mix concrete	Ready mix concrete	27.87	0.72

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
34	70300NB4014	31.4 MPa 28d strength Ready mix concrete	Ready mix concrete	31.40	0.68
36	73300NB0514	31.6 MPa 28d strength mortars and fillers	Mortars and fillers	31.60	0.73
37	70320ND2010	34.34 MPa 28d strength Ready mix concrete	Ready mix concrete	34.34	0.63

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
38	70350NB2014	36.6 MPa 28d strength Ready mix concrete	Ready mix concrete	36.60	0.57
39	56350NB1265	40 MPa 28d strength special concrete	Special concrete	40.00	0.48
40	73350NB0514	38 MPa 28d strength mortars and fillers	Mortars and fillers	38.00	0.66
41	70360ND2010	37.29 MPa 28d strength Ready mix concrete	Ready mix concrete	37.29	0.55

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	42.29 MPa 28d strength Ready mix concrete	Ready mix concrete	42.29	0.59
42	70400ND2010	41 MPa 28d strength Ready mix concrete	Ready mix concrete	41.00	0.52
43	60400NB2014	43.42 MPa 28d strength special concrete	Special concrete	43.42	0.53

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	13450NB2014	46.71 MPa 28d strength Ready mix concrete	Ready mix concrete	46.71	0.5

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	60.53ND2012	53.58 MPa 28d strength Ready mix concrete	Ready mix concrete	53.58	0.58
35	56300NB1265	50.04 MPa 28d strength special concrete	Special concrete	50.04	0.50
45	13500NB2014	52.5 MPa 28d strength Ready mix concrete	Ready mix concrete	52.50	0.45

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
46	13550NB2014	55.44 MPa 28d strength Ready mix concrete	Ready mix concrete	55.44	0.42

READY MIX CONCRETE DESIGN COMPOSITION

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

Table 11: **Design composition**

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

SYSTEM BOUNDARIES

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

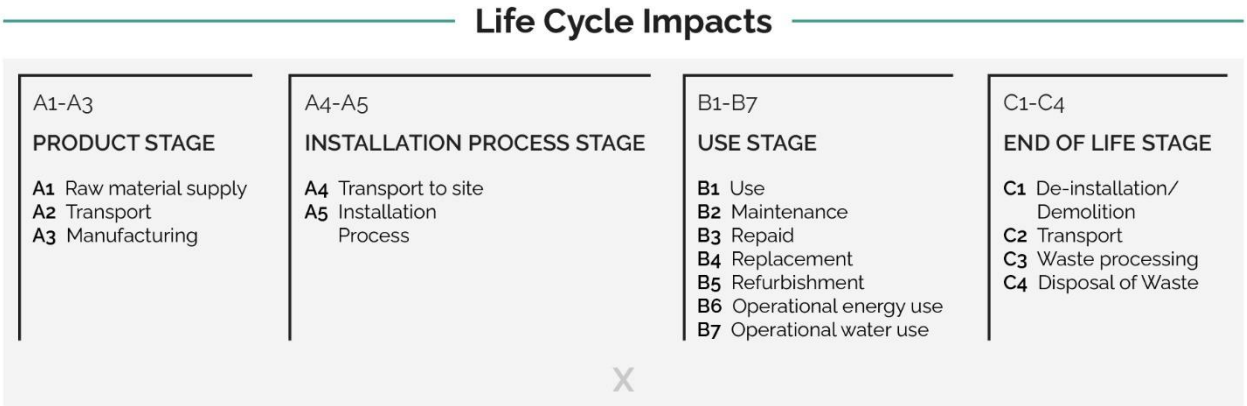

Figure 1: **General life cycle phases for consideration in a construction works system**

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).

System Boundary

Raw Material Supply (A1)	Transport (A2)	Manufacturing (A3)
Cements & SCMs Aggregates Admixtures Batch Water Fibers & Pigments	Truck, Rail, Ship Energy Carriers (fuels)	Energy Carriers (electricity and fuels) Ancillary Materials (lubricants, motor oil, cleaning chemicals, other consumables) Water (manufacturing water, including wash water for cement trucks, but excluding batch water) Waste (end of life treatment of ancillary materials and any packaging) 30% total fleet energy transit mix plants only

- 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 II facility in México. All operating data is formulated using the actual data from Holcim México Operaciones S.A. de C.V.'s plant at the above location, including water, energy consumption and waste generation. All inputs for this system boundary are calculated for the plant.

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

CUT-OFF CRITERIA

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

DATA SOURCES AND DATA QUALITY ASSESSMENT

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

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

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

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

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

Recovered energy: Not applicable.

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

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

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

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

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

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

Table 12: **LCI inputs assumed for module A1 (i.e. raw material supply)** ***Data Quality Assessment Key Fair=1, Good=2, Very Good =3.***

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
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: AHR0 Hermosillo - Cement Plant	CPC 40	Progam Operator: Labeling Sustainability- EPD ID: 30af63b7-21b3-4892-8cda-fa4df53f61d5	Sonora	28 March 2023	3	NA	3	3	3
Natural River sand	sand quarry operation, extraction from river bed/sand/BR/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	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 (see tables below).

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

LIMITATIONS

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

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

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

TOTAL IMPACT SUMMARY

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

Mix designs: 0 to 15 MPa

Table 13: **Total life cycle (across modules in scope) impact results for Mix designs: 0 to 15MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	24.3	0.204	207	1.39e-05	0.383	0.000262	1070
Maximum	67.6	0.266	539	3.8e-05	1.01	0.000759	2940
Mean	47.6	0.237	383	2.68e-05	0.719	0.000532	2070
Median	49.8	0.241	399	2.8e-05	0.752	0.000564	2180
24015ND0518	24.3	0.204	207	1.39e-05	0.383	0.000262	1070
77035NB4014	49.7	0.241	398	2.79e-05	0.75	0.000559	2160
60035NB2018	50.7	0.242	406	2.84e-05	0.764	0.00057	2200
24035NB0518	28.7	0.21	241	1.64e-05	0.446	0.000314	1270
77036ND4010	46.3	0.236	373	2.6e-05	0.704	0.000493	1950
77038ND4006	48.3	0.238	388	2.7e-05	0.731	0.000528	2060
68038ND4010	49.8	0.241	399	2.8e-05	0.752	0.000564	2180
77040ND4010	52	0.244	415	2.91e-05	0.782	0.000584	2250
68040ND4010	51.9	0.244	415	2.91e-05	0.781	0.000591	2280
77042ND2014	53.4	0.246	426	2.99e-05	0.803	0.000607	2340
68042ND4010	54.1	0.247	432	3.03e-05	0.813	0.000613	2360
77045ND4010	59.1	0.254	471	3.31e-05	0.885	0.000664	2560
68045ND4010	58.7	0.253	468	3.3e-05	0.879	0.000669	2580
77048NB4014	67.6	0.266	539	3.8e-05	1.01	0.000759	2940
77050ND4010	67.5	0.266	538	3.8e-05	1.01	0.000754	2930
76050NB1018	38.4	0.224	319	2.19e-05	0.586	0.000429	1710
11050NB0514	30.5	0.213	253	1.74e-05	0.474	0.000341	1370
70100NB2014	32.6	0.216	264	1.83e-05	0.503	0.000363	1420
11100NB0524	39.9	0.226	328	2.27e-05	0.609	0.000449	1770

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	1170	25.3	1140	28.7	0.000243	5.09	118	0.00135	0.00178	0.000101	0.0042	105
Maximum	3220	71.6	3150	78.8	0.000497	15.8	129	0.00251	2.82	0.000101	0.0042	105
Mean	2270	49.7	2210	55.3	0.000382	8.46	124	0.00198	0.379	0.000101	0.0042	105
Median	2380	52	2320	58.1	4e-04	6.62	125	0.00205	0.253	0.000101	0.0042	105
24015ND0518	1170	25.3	1140	28.7	0.000243	13.7	118	0.00135	0.3	0.000101	0.0042	105

77035NB4014	2370	51.9	2300	57.5	0.000398	6.92	125	0.00204	0.256	0.000101	0.0042	105
60035NB2018	2410	52.7	2340	58.6	4e-04	6.59	119	0.00206	0.258	0.000101	0.0042	105
24035NB0518	1390	30	1350	34	0.000275	13.5	124	0.00147	0.3	0.000101	0.0042	105
77036ND4010	2140	47.5	2080	51.9	0.000335	7.63	124	0.00193	0.00178	0.000101	0.0042	105
77038ND4006	2240	49.1	2200	54.7	0.00036	6.34	125	0.00198	0.236	0.000101	0.0042	105
68038ND4010	2380	52	2320	58.1	4e-04	6.97	125	0.00205	0.25	0.000101	0.0042	105
77040ND4010	2460	53.9	2420	59.9	0.000401	5.91	125	0.00209	0.246	0.000101	0.0042	105
68040ND4010	2490	54.3	2430	60.8	0.000419	6.62	126	0.00211	0.253	0.000101	0.0042	105
77042ND2014	2560	56	2500	62.2	0.000425	6.29	126	0.00215	0.246	0.000101	0.0042	105
68042ND4010	2590	56.8	2500	62.9	0.000429	6.29	125	0.00216	0.251	0.000101	0.0042	105
77045ND4010	2800	62.4	2750	68.3	0.000442	5.21	127	0.00228	0.248	0.000101	0.0042	105
68045ND4010	2810	62.1	2760	68.6	0.000461	5.92	127	0.00228	0.262	0.000101	0.0042	105
77048NB4014	3220	71.6	3150	78.8	0.000497	5.09	129	0.0025	0.276	0.000101	0.0042	105
77050ND4010	3220	70.3	3130	77.9	0.000492	5.69	129	0.00251	0.232	0.000101	0.0042	105
76050NB1018	1870	40.7	1820	45.8	0.000335	12.3	121	0.00172	0.268	0.000101	0.0042	105
11050NB0514	1500	32.1	1450	36.6	0.000297	14.2	120	0.00156	0.247	0.000101	0.0042	105
70100NB2014	1550	33	1500	37.7	0.000294	9.79	121	0.0016	0.253	0.000101	0.0042	105
11100NB0524	1940	43.2	1880	47.7	0.000363	15.8	121	0.00179	2.82	0.000101	0.0042	105

Mix designs: 15 to 20 MPa

Table 14: **Total life cycle (across modules in scope) impact results for Mix designs: 15 to 20MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	37.1	0.222	298	2.07e-05	0.566	0.000415	1600
Maximum	43.2	0.231	353	2.46e-05	0.657	0.000482	1920
Mean	39.4	0.226	318	2.21e-05	0.599	0.000442	1720

Median	38.6	0.224	310	2.16e-05	0.587	0.000434	1680
70150NB2018	38.1	0.224	307	2.13e-05	0.581	0.000427	1660
60150ND2012	39	0.225	313	2.18e-05	0.594	0.000442	1700
73150NB0514	43.2	0.231	353	2.46e-05	0.657	0.000482	1920
70175ND2014	37.1	0.222	298	2.07e-05	0.566	0.000415	1600

b) Inventory Metrics:

Indicator/LCI Metric	**TPE**	**RE**	**NRE**	**NRR**	**RR**	**WDP**	**LFW**	**LFHW**	**CBWC**	**CWWC**	**CHW**	**CNHW**
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m3**	**m3**	**kg waste**	**kg waste**	**m3**	**m3**	**kg**	**kg**
Minimum	1760	38.1	1720	42.7	0.000323	8.09	122	0.00171	0.237	0.000101	0.0042	105
Maximum	2100	46.1	2050	51.4	0.000371	13.2	122	0.00189	0.26	0.000101	0.0042	105
Mean	1880	41	1840	45.8	0.00034	9.7	122	0.00178	0.248	0.000101	0.0042	105
Median	1840	39.8	1800	44.7	0.000334	8.76	122	0.00175	0.246	0.000101	0.0042	105
70150NB2018	1820	39.3	1770	44.1	0.000328	9.03	122	0.00174	0.26	0.000101	0.0042	105
60150ND2012	1860	40.3	1820	45.2	0.000339	8.09	122	0.00176	0.25	0.000101	0.0042	105
73150NB0514	2100	46.1	2050	51.4	0.000371	13.2	122	0.00189	0.243	0.000101	0.0042	105
70175ND2014	1760	38.1	1720	42.7	0.000323	8.49	122	0.00171	0.237	0.000101	0.0042	105

Mix designs: 21 to 25 MPa

Table 15: **Total life cycle (across modules in scope) impact results for Mix designs: 21 to 25MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	**AP**	**EP**	**GWP**	**ODP**	**PCOP**	**ADPe**	**ADPf**
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	39.1	0.225	313	2.18e-05	0.595	0.000438	1690
Maximum	47.9	0.238	389	2.73e-05	0.728	0.000535	2130

Mean	42.8	0.23	344	2.41e-05	0.65	0.000481	1870
Median	42.2	0.23	338	2.41e-05	0.65	0.000481	1830
70200NB2016	41.8	0.229	335	2.34e-05	0.635	0.000468	1810
60200ND2012	42.5	0.23	340	2.37e-05	0.644	0.000483	1850
73200NB0514	47.9	0.238	389	2.73e-05	0.728	0.000535	2130
70210ND4010	39.1	0.225	313	2.18e-05	0.595	0.000438	1690

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	1840	40	1800	45	0.000333	7.43	122	0.00177	0.22	0.000101	0.0042	105
Maximum	2330	51	2280	57	4e-04	13.8	124	0.00204	0.252	0.000101	0.0042	105
Mean	2050	44.6	2000	50	0.000362	9.38	123	0.00188	0.24	0.000101	0.0042	105
Median	2010	43.6	1960	49	0.000356	8.14	123	0.00184	0.244	0.000101	0.0042	105
70200NB2016	1990	43	1940	48.5	0.000352	8.24	123	0.00184	0.252	0.000101	0.0042	105
60200ND2012	2030	44.2	1980	49.4	0.000361	7.43	123	0.00185	0.242	0.000101	0.0042	105
73200NB0514	2330	51	2280	57	4e-04	13.8	124	0.00204	0.245	0.000101	0.0042	105
70210ND4010	1840	40	1800	45	0.000333	8.03	122	0.00177	0.22	0.000101	0.0042	105

Mix designs: 26 to 30 MPa

Table 16: **Total life cycle (across modules in scope) impact results for Mix designs: 26 to 30MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	**AP**	**EP**	**GWP**	**ODP**	**PCOP**	**ADPe**	**ADPf**
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	42	0.229	337	2.35e-05	0.638	0.000474	1820

Maximum	52	0.244	423	2.96e-05	0.785	0.000584	2310
Mean	46.4	0.236	374	2.61e-05	0.703	0.000524	2040
Median	45.8	0.236	367	2.57e-05	0.694	0.00052	2000
70250ND2010	42.1	0.23	337	2.35e-05	0.639	0.000475	1830
60250ND4012	42	0.229	337	2.35e-05	0.638	0.000474	1820
73250NB0514	52	0.244	423	2.96e-05	0.785	0.000584	2310
70280ND2006	49.6	0.241	397	2.79e-05	0.749	0.000565	2180

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	1980	43.3	1950	48.6	0.000352	7.39	123	0.00184	0.223	0.000101	0.0042	105
Maximum	2550	55.5	2470	62.2	0.000424	12.7	125	0.00212	0.252	0.000101	0.0042	105
Mean	2220	48.6	2180	54.4	0.000388	8.77	124	0.00197	0.243	0.000101	0.0042	105
Median	2180	47.8	2140	53.4	0.000388	7.5	124	0.00195	0.248	0.000101	0.0042	105
70250ND2010	1990	43.3	1950	48.8	0.000352	7.39	123	0.00184	0.223	0.000101	0.0042	105
60250ND4012	1980	43.5	1950	48.6	0.000358	7.41	123	0.00184	0.252	0.000101	0.0042	105
73250NB0514	2550	55.5	2480	62.2	0.000424	12.7	124	0.00212	0.248	0.000101	0.0042	105
70280ND2006	2380	52	2330	58	0.000417	7.59	125	0.00206	0.248	0.000101	0.0042	105

Mix designs: 31 to 35 MPa

Table 17: **Total life cycle (across modules in scope) impact results for Mix designs: 31 to 35MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	**AP**	**EP**	**GWP**	**ODP**	**PCOP**	**ADPe**	**ADPf**
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	52.6	0.245	421	2.96e-05	0.792	0.000597	2300

Maximum	58.5	0.253	476	3.34e-05	0.88	0.00066	2610
Mean	55.2	0.248	444	3.12e-05	0.83	0.000625	2430
Median	54.5	0.247	435	3.06e-05	0.819	0.000618	2380
70300NB4014	52.6	0.245	421	2.96e-05	0.792	0.000597	2300
73300NB0514	58.5	0.253	476	3.34e-05	0.88	0.00066	2610
70320ND2010	54.5	0.247	435	3.06e-05	0.819	0.000618	2380

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	2520	55	2470	62	0.000422	6.57	126	0.00213	0.244	0.000101	0.0042	105
Maximum	2870	62.8	2780	69.8	0.000466	11.9	126	0.00228	0.317	0.000101	0.0042	105
Mean	2670	58.3	2600	64.9	0.000439	8.51	126	0.00219	0.271	0.000101	0.0042	105
Median	2610	57	2550	63.6	0.00043	7.07	126	0.00217	0.253	0.000101	0.0042	105
70300NB4014	2520	55	2470	62	0.000422	7.07	126	0.00213	0.253	0.000101	0.0042	105
73300NB0514	2870	62.8	2780	69.8	0.000466	11.9	126	0.00228	0.317	0.000101	0.0042	105
70320ND2010	2610	57	2550	63.6	0.00043	6.57	126	0.00217	0.244	0.000101	0.0042	105

Mix designs: 36 to 40 MPa

Table 18: **Total life cycle (across modules in scope) impact results for Mix designs: 41 to 45MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	**AP**	**EP**	**GWP**	**ODP**	**PCOP**	**ADPe**	**ADPf**
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	61.3	0.257	489	3.44e-05	0.917	0.000696	2690

Maximum	74	0.276	587	4.19e-05	1.1	0.000876	3360
Mean	65.5	0.264	524	3.7e-05	0.979	0.000753	2920
Median	63.4	0.26	510	3.59e-05	0.95	0.00072	2810
70350NB2014	62	0.258	494	3.48e-05	0.927	0.000704	2720
56350NB1265	74	0.276	587	4.19e-05	1.1	0.000876	3360
73350NB0514	64.9	0.263	526	3.7e-05	0.972	0.000735	2900
70360ND2010	61.3	0.257	489	3.44e-05	0.917	0.000696	2690

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	2930	64.3	2870	71.7	0.000472	6.09	127	0.00235	0.246	0.000101	0.0042	105
Maximum	3660	80.2	3590	89.8	0.000611	11.5	131	0.00277	0.322	0.000101	0.0042	105
Mean	3180	70.2	3120	77.9	0.000518	8.21	128	0.00249	0.272	0.000101	0.0042	105
Median	3060	68.1	3000	75.1	0.000494	7.62	128	0.00241	0.259	0.000101	0.0042	105
70350NB2014	2980	65.4	2900	72.6	0.000477	6.45	128	0.00237	0.257	0.000101	0.0042	105
56350NB1265	3660	80.2	3590	89.8	0.000611	8.79	131	0.00277	0.261	0.000101	0.0042	105
73350NB0514	3150	70.7	3100	77.6	0.000511	11.5	127	0.00245	0.322	0.000101	0.0042	105
70360ND2010	2930	64.3	2870	71.7	0.000472	6.09	128	0.00235	0.246	0.000101	0.0042	105

Mix designs: 41 to 45 MPa

Table 19: **Total life cycle (across modules in scope) impact results for Mix designs: 41 to 45MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf

Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	62	0.258	494	3.49e-05	0.929	0.000702	2710
Maximum	72.3	0.273	574	4.07e-05	1.08	0.000849	3240
Mean	66.5	0.265	529	3.74e-05	0.994	0.000763	2930
Median	65.1	0.263	519	3.66e-05	0.974	0.000739	2850
19.45NB2014	72.3	0.273	574	4.07e-05	1.08	0.000849	3240
70400ND2010	65.1	0.263	519	3.66e-05	0.974	0.000739	2850
60400NB2014	62	0.258	494	3.49e-05	0.929	0.000702	2710

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	65.3	2890	72.4	0.000479	5.79	128	0.00238	0.242	0.000101	0.0042	105
Maximum	3560	77.6	3470	86.4	0.000583	6.01	130	0.00268	0.257	0.000101	0.0042	105
Mean	3220	70.6	3140	78.4	0.000518	5.88	129	0.0025	0.249	0.000101	0.0042	105
Median	3130	68.9	3060	76.4	0.000491	5.85	128	0.00245	0.247	0.000101	0.0042	105
19.45NB2014	3560	77.6	3470	86.4	0.000583	5.85	130	0.00268	0.257	0.000101	0.0042	105
70400ND2010	3130	68.9	3060	76.4	0.000491	5.79	128	0.00245	0.247	0.000101	0.0042	105
60400NB2014	2970	65.3	2890	72.4	0.000479	6.01	128	0.00238	0.242	0.000101	0.0042	105

Mix designs: 46 to 50 MPa

Table 20: **Total life cycle (across modules in scope) impact results for Mix designs: 46 to 50MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf

Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
13450NB2014	70.1	0.27	558	3.95e-05	1.04	0.000806	3100

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
13450NB2014	3380	75.5	3310	83	0.000543	5.97	130	0.0026	0.258	0.000101	0.0042	105

Mix designs: 51 to 55 MPa

Table 21: **Total life cycle (across modules in scope) impact results for Mix designs: 51 to 55MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	62	0.258	495	3.49e-05	0.928	0.000699	2710
Maximum	77.2	0.278	613	4.35e-05	1.15	0.000889	3420
Mean	70.1	0.27	558	3.95e-05	1.05	0.000804	3100
Median	71	0.271	566	4.02e-05	1.06	0.000824	3180
60.53ND2012	62	0.258	495	3.49e-05	0.928	0.000699	2710
56300NB1265	71	0.271	566	4.02e-05	1.06	0.000824	3180
13500NB2014	77.2	0.278	613	4.35e-05	1.15	0.000889	3420

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	2960	65.7	2900	72.6	0.000467	5.52	128	0.00237	0.261	0.000101	0.0042	105
Maximum	3760	82.4	3670	91.8	0.000592	8.94	131	0.0028	0.264	0.000101	0.0042	105
Mean	3400	75	3330	83.2	0.000544	6.83	130	0.00261	0.262	0.000101	0.0042	105
Median	3490	76.8	3430	85.1	0.000572	6.04	130	0.00267	0.262	0.000101	0.0042	105
60.53ND2012	2960	65.7	2900	72.6	0.000467	6.04	128	0.00237	0.264	0.000101	0.0042	105
56300NB1265	3490	76.8	3430	85.1	0.000572	8.94	130	0.00267	0.261	0.000101	0.0042	105
13500NB2014	3760	82.4	3670	91.8	0.000592	5.52	131	0.0028	0.262	0.000101	0.0042	105

Mix designs: 56 to 60 MPa

Table 22: **Total life cycle (across modules in scope) impact results for Mix designs: 56 to 60MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	**AP**	**EP**	**GWP**	**ODP**	**PCOP**	**ADPe**	**ADPf**
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
13550NB2014	86.6	0.293	688	4.88e-05	1.28	0.000985	3810

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	4170	92.9	4090	102	0.000625	4.72	133	0.00303	0.276	0.000101	0.0042	105

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.