

Environmental Product Declaration



Environmental Product Declaration for ready mix concrete products produced by Holcim Colombia at their Sibaté facility in Cundinamarca, Colombia

ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers concrete products produced by Holcim Colombia. Declared unit: 1 m3 of concrete
Declaration Owner:	<div>Holcim Colombia</div> <div>7-45 Calle 13, Piso 12, Torre B, Ed. Teleport Business Park</div> <div>Bogotá, Colombia</div> <div>www.holcim.com.co</div>
Program Operator:	<div>Labeling Sustainability</div> <div>Address, 11670 W Sunset Blvd.</div> <div>City, State, Los Angeles, CA</div> <div>www.labelinsustainability.com/</div>
Product Category Rule:	<div>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</div> <div>Sub PCR Program Operator: NSF International</div> <div>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.</div>
Independent LCA Reviewer and EPD Verifier:	<div>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.</div> <div>Independent verification of the declaration, according to ISO 14025:2006</div> <div>Internal <input type="checkbox"/> ; External X</div> <div>Third Party Verifier</div> <div>Geoffrey Guest, Certified 3rd Party Verifier under the International EPD Program (www.environdec.com), CSA Group (www.csaregistry.ca)</div>
Date of Issue:	29 April 2023
Period of Validity:	5 years; valid until 29 April 2028
EPD Number:	b7c1955a-efc7-4c59-9add-d198d8966a02



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COMPANY DESCRIPTION

Holcim Colombia, as part of Grupo Holcim, a world leader in innovative and sustainable solutions for construction, is making it possible to have greener cities, smarter infrastructures and improve the standard of living of people around the world. With sustainability at the heart of its strategy, Holcim is becoming a Net Zero company, where its people and communities are the foundation of its success. The company is driving circular construction as a world leader in recycling to build more with less.

Holcim Colombia produces and markets cement, ready-mix concrete, aggregates (gravel and sand) and other products and solutions for construction. Additionally, it offers the GacoFlex TechoProtec waterproofing line and the Tector family of adhesives and mortars. The company has a team passionate about building progress for people and the planet. It has a national presence through 1 cement plant, 10 ready-mix concrete plants, 1 Geocycle platform, 1 aggregates plant, its own network of hardware stores, Disensa, with more than 400 stores nationwide; and offers specialized services for transporting materials or products through Transcem.

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 Colombia 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 Colombia 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 Colombia's license to operate in the community. The intended audience for this LCA report is Holcim Colombia's employees, their suppliers, project specifiers of their products, architects, and engineers. The EPD report is also available for policy makers, government officials interested in sustainability, academic professors, and LCA professionals. This LCA report does not include product comparisons from other facilities.

DESCRIPTION OF PRODUCT AND SCOPE

This EPD reports on 56 concrete mixes manufactured at the Holcim Colombia, Sibaté, concrete facility in Cundinamarca, Colombia.



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 cement products considered in this EPD along with key performance parameters.

Mix Designs: 0 to 15MPa

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	H ₂ O to cement ratio
1	10062890	2 MPa 28d strength ready mix concrete.	Ready Mix	2.0	1.400000
2	10047801	4 MPa 28d strength ready mix concrete.	Ready Mix	4.0	0.458333
3	10064056	4.1 MPa 28d strength ready mix concrete.	Ready Mix	4.1	0.281818
4	10011208	4.1 MPa 28d strength ready mix concrete.	Ready Mix	4.1	0.369565
5	10051184	4.2 MPa 28d strength ready mix concrete.	Ready Mix	4.2	0.310680
6	10073454	4.3 MPa 28d strength ready mix concrete.	Ready Mix	4.3	0.304762
7	10011451	4.3 MPa 28d strength ready mix concrete.	Ready Mix	4.3	0.423077
8	10065278	4.5 MPa 28d strength ready mix concrete.	Ready Mix	4.5	0.442857
9	10011461	4.5 MPa 28d strength ready mix concrete.	Ready Mix	4.5	0.402439
10	10062841	4.5 MPa 28d strength ready mix concrete.	Ready Mix	4.5	0.326316
11	10011463	4.5 MPa 28d strength ready mix concrete.	Ready Mix	4.5	0.311321
12	10064058	4.5 MPa 28d strength ready mix concrete.	Ready Mix	4.5	0.260504
13	10033497	5 MPa 28d strength ready mix concrete.	Ready Mix	5.0	0.271930
14	10067123	10.5 MPa 28d strength ready mix concrete.	Ready Mix	10.5	0.817308
15	10067129	10.5 MPa 28d strength ready mix concrete.	Ready Mix	10.5	0.767544
16	10067202	10.5 MPa 28d strength ready mix concrete.	Ready Mix	10.5	0.711462



17	10045441	10.5 MPa 28d strength ready mix concrete.	Ready Mix	10.5	0.649123
18	10072811	12.5 MPa 28d strength ready mix concrete.	Ready Mix	12.5	0.571429
19	10067124	14 MPa 28d strength ready mix concrete.	Ready Mix	14.0	0.745614
20	10067200	14 MPa 28d strength ready mix concrete.	Ready Mix	14.0	0.705645
21	10011892	14 MPa 28d strength ready mix concrete.	Ready Mix	14.0	0.625000

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	H ₂ O to cement ratio
22	10067219	17.5 MPa 28d strength ready mix concrete.	Ready Mix	17.5	0.741525
23	10067201	17.5 MPa 28d strength ready mix concrete.	Ready Mix	17.5	0.652985
24	10032165	17.5 MPa 28d strength ready mix concrete.	Ready Mix	17.5	0.615385

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	H ₂ O to cement ratio
25	10066981	21 MPa 28d strength ready mix concrete.	Ready Mix	21.0	0.611940
26	10073458	21 MPa 28d strength ready mix concrete.	Ready Mix	21.0	0.610169
27	10060245	21 MPa 28d strength ready mix concrete.	Ready Mix	21.0	0.537313
28	10029084	21 MPa 28d strength ready mix concrete.	Ready Mix	21.0	0.546667
29	10072702	21 MPa 28d strength ready mix concrete.	Ready Mix	21.0	0.445783
30	10011050	24.5 MPa 28d strength ready mix concrete.	Ready Mix	24.5	0.620690
31	10048467	24.5 MPa 28d strength ready mix concrete.	Ready Mix	24.5	0.578125
32	10041261	24.5 MPa 28d strength ready mix concrete.	Ready Mix	24.5	0.513889
33	10072802	24.5 MPa 28d strength ready mix concrete.	Ready Mix	24.5	0.481928



Mix Designs: 26 to 30 MPa

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

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H ₂ O to cement ratio
34	10011079	28 MPa 28d strength ready mix concrete.	Ready Mix	28	0.580645
35	10068980	28 MPa 28d strength ready mix concrete.	Ready Mix	28	0.537791
36	10010699	28 MPa 28d strength ready mix concrete.	Ready Mix	28	0.513158
37	10010840	28 MPa 28d strength ready mix concrete.	Ready Mix	28	0.428571
38	10062076	28 MPa 28d strength ready mix concrete.	Ready Mix	28	0.375000

Mix Designs: 31 to 35 MPa

Table 5: Declared products with Mix designs: 31 to 35 MPa considered in this environmental product declaration

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H ₂ O to cement ratio
39	10041259	31.5 MPa 28d strength ready mix concrete.	Ready Mix	31.5	0.545455
40	10045331	31.5 MPa 28d strength ready mix concrete.	Ready Mix	31.5	0.486842
41	10065388	31.5 MPa 28d strength ready mix concrete.	Ready Mix	31.5	0.439560
42	10041258	35 MPa 28d strength ready mix concrete.	Ready Mix	35.0	0.514286
43	10072763	35 MPa 28d strength ready mix concrete.	Ready Mix	35.0	0.468354
44	10067191	35 MPa 28d strength ready mix concrete.	Ready Mix	35.0	0.400000

Mix Designs: 36 to 40 MPa

Table 6: Declared products with Mix designs: 36 to 40 MPa considered in this environmental product declaration

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H ₂ O to cement ratio
45	10058499	38.5 MPa 28d strength ready mix concrete.	Ready Mix	38.5	0.486486
46	10062563	38.5 MPa 28d strength ready mix concrete.	Ready Mix	38.5	0.409091



Mix Designs: 41 to 45 MPa

Table 7: Declared products with Mix designs: 41 to 45 MPa considered in this environmental product declaration

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
47	10048460	42 MPa 28d strength ready mix concrete.	Ready Mix	42	0.402439
48	10027316	42 MPa 28d strength ready mix concrete.	Ready Mix	42	0.411111
49	10048322	42 MPa 28d strength ready mix concrete.	Ready Mix	42	0.360000
50	10062291	45 MPa 28d strength ready mix concrete.	Ready Mix	45	0.377574

Mix Designs: 46 to 50 MPa

Table 8: Declared products with Mix designs: 46 to 50 MPa considered in this environmental product declaration

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
51	10052003	45.5 MPa 28d strength ready mix concrete.	Ready Mix	45.5	0.420455
52	10052062	49 MPa 28d strength ready mix concrete.	Ready Mix	49.0	0.418605
53	10049785	49 MPa 28d strength ready mix concrete.	Ready Mix	49.0	0.385417
54	10072161	49 MPa 28d strength ready mix concrete.	Ready Mix	49.0	0.298246

Mix Designs: 56 to 60 MPa

Table 9: Declared products with Mix designs: 56 to 60 MPa considered in this environmental product declaration

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
55	10072640	56 MPa 28d strength ready mix concrete.	Ready Mix	56	0.327434
56	10049790	56 MPa 28d strength ready mix concrete.	Ready Mix	56	0.330097



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 10: Ready mix concrete composition

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

SYSTEM BOUNDARIES

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

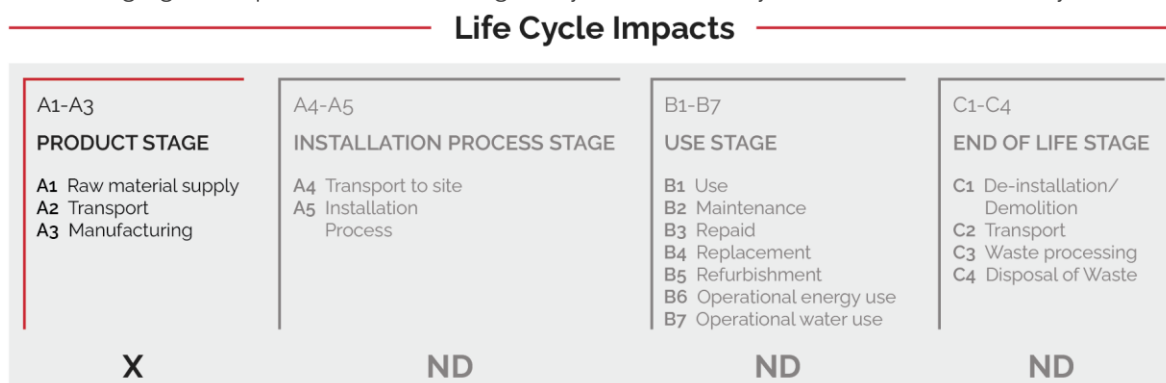


Figure 1: General life cycle phases for consideration in a construction works system

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

- A1: Raw material supply (upstream processes) - Extraction, handling, and processing of the materials used in manufacturing the declared products in this LCA.
- A2: Transportation - Transportation of A1 materials from the supplier to the "gate" of the manufacturing facility (i.e. A3).
- A3: Manufacturing (core processes)- The energy and other utility inputs used to store, move, and manufacture 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 cement products and is not necessarily exhaustive.

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

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 Colombia, is located at their Planta Sibaté facility in Colombia. All operating data is formulated using the actual data from Holcim Colombia'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 Colombia 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 Colombia in calendar year 2021. These values were direct reported from Colombia records. The unit process "market for electricity, medium voltage/electricity, medium voltage/CO/kWh" was used to represent the Colombia 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. This plant does not have electricity therefore it uses diesel to power generators.

Waste generation: Waste generation values are directly reported from Holcim operations for 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 Colombia for 2021.

Recovered energy: Not applicable.

Recycled/reused material/components: The amount of returned concrete is based on Holcim primary data for the reference year, 2021.

Module A1 material losses: Due to lack of data, default loss factors were assumed.

Direct A3 emissions accounting: Direct emissions for the on-site machinery use the actual fuel consumption and the ecoinvent database to calculate those emissions.

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 2021.

Product transport requirements: The diesel fuel used by the mixing trucks is direct primary information reported from Holcim Colombia records for the year 2021. Holcim records their fuel for their trucks in L/km and therefore the information was converted with the following formula: $(\text{Ave. km to site})^2 \text{ for return L diesel/km} / (\text{ave. m}^3 \text{ of concrete in a load}) \text{ total concrete volume in m}^3 \cdot \text{fraction allocated to A3}$. A4 is outside the scope of this study.

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 11: 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 treatment/tap water/RoW/kg	ecoinvent v3.8	Cundinamarca	v3.8 in 2021	2	3	2	3	3
Additives	market for chemical, organic/chemical, organic/GLO/kg	ecoinvent v3.8	Cundinamarca	v3.8 in 2021	2	3	2	3	3
Cement	HE Cement	Progam Operator: Labeling Sustainability- EPD ID: 6328e320-6cab-4d85-83f4-dca33374d11b	Boaycá	06 January 2023	3	3	3	3	3
Sand	sand quarry operation, extraction from river bed/sand/BR/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	Cundinamarca	v3.8 in 2021	2	3	2	3	3
Gravel	gravel production, crushed/gravel, crushed/BR/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	Cundinamarca	v3.8 in 2021	2	3	2	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 Cement 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 2021-01-01 to 2021-12-31.
- 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 cement facility on a per 1m³ of concrete basis.

Mix Designs: 0 to 15 MPa

Table 12: **Total life cycle (across modules in scope) impact results for All declared products, 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	32.9	0.13	219	2.32e-05	0.49	0.000898	1630
Maximum	84.1	0.204	592	5.09e-05	1.24	0.00251	3570
Mean	59.9	0.168	408	3.67e-05	0.887	0.00171	2570
Median	58.5	0.166	391	3.69e-05	0.874	0.00163	2580
10062890	32.9	0.13	219	2.32e-05	0.49	0.000898	1630
10047801	58.5	0.166	388	3.48e-05	0.87	0.00163	2440
10064056	79.1	0.196	551	4.72e-05	1.16	0.00232	3310
10011208	69.2	0.181	471	4.08e-05	1.02	0.00198	2860
10051184	75.2	0.19	521	4.5e-05	1.11	0.0022	3150
10073454	76.6	0.193	534	4.66e-05	1.13	0.00225	3260
10011451	61.6	0.17	414	3.69e-05	0.915	0.00174	2580
10065278	58.4	0.165	378	3.37e-05	0.874	0.00159	2360
10011461	63.8	0.174	431	3.82e-05	0.945	0.00181	2680
10062841	71.6	0.185	487	4.24e-05	1.06	0.00205	2970
10011463	76.7	0.193	532	4.57e-05	1.13	0.00224	3200
10064058	84.1	0.204	592	5.09e-05	1.24	0.00251	3570
10033497	81.3	0.199	567	4.83e-05	1.2	0.00239	3390
10067123	41.7	0.14	256	2.43e-05	0.63	0.00106	1710
10067129	43.3	0.143	275	2.6e-05	0.651	0.00114	1830
10067202	45.9	0.147	296	2.76e-05	0.688	0.00123	1940
10045441	47.6	0.153	340	3.34e-05	0.697	0.00142	2340
10072811	50.9	0.159	391	3.69e-05	0.735	0.00163	2580
10067124	43.8	0.144	274	2.57e-05	0.66	0.00114	1810
10067200	45.4	0.147	292	2.74e-05	0.681	0.00122	1920
10011892	50.9	0.158	369	3.56e-05	0.744	0.00155	2490



b) Inventory Metrics:

Indicator/LC I Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFH W	CBW C	CW WC	CHW	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	1800	80.7	1730	44.8	0.000788	4.46	115	0.00289	0.163	1.33e-05	0.00233	48.1
Maximum	4060	250	3800	97.3	0.00169	12.7	183	0.0046	0.22	1.33e-05	0.00233	48.1
Mean	2910	169	2740	70.2	0.00126	7.42	148	0.00374	0.179	1.33e-05	0.00233	48.1
Median	2900	162	2750	70.4	0.0012	6.55	148	0.00385	0.173	1.33e-05	0.00233	48.1
10062890	1800	80.7	1730	44.8	0.000788	12.4	115	0.00317	0.22	1.33e-05	0.00233	48.1
10047801	2760	162	2590	66.8	0.0012	6.74	143	0.00356	0.173	1.33e-05	0.00233	48.1
10064056	3770	234	3530	90.1	0.00161	4.9	173	0.00429	0.163	1.33e-05	0.00233	48.1
10011208	3260	200	3050	78.4	0.00137	5.15	157	0.00385	0.178	1.33e-05	0.00233	48.1
10051184	3580	220	3350	86.2	0.00147	5.29	168	0.00416	0.168	1.33e-05	0.00233	48.1
10073454	3700	225	3480	88.6	0.00158	6.34	172	0.00437	0.168	1.33e-05	0.00233	48.1
10011451	2930	173	2750	70.4	0.00127	6.55	148	0.00369	0.173	1.33e-05	0.00233	48.1
10065278	2680	160	2520	64.6	0.00118	6.01	140	0.00345	0.163	1.33e-05	0.00233	48.1
10011461	3040	180	2840	73	0.00131	6.41	151	0.00377	0.173	1.33e-05	0.00233	48.1
10062841	3370	206	3180	81.1	0.00149	5.62	162	0.00402	0.163	1.33e-05	0.00233	48.1
10011463	3620	225	3410	87	0.00156	4.79	169	0.00416	0.173	1.33e-05	0.00233	48.1
10064058	4060	250	3800	97.3	0.00169	5.41	183	0.0046	0.163	1.33e-05	0.00233	48.1
10033497	3870	241	3610	92.5	0.00168	4.46	176	0.00433	0.163	1.33e-05	0.00233	48.1
10067123	1920	105	1800	46.8	0.000885	7.61	117	0.00289	0.178	1.33e-05	0.00233	48.1
10067129	2040	112	1940	49.8	0.000928	7.98	121	0.00303	0.183	1.33e-05	0.00233	48.1
10067202	2180	121	2060	52.9	0.000976	7.76	125	0.00312	0.189	1.33e-05	0.00233	48.1
10045441	2610	131	2470	63.6	0.00113	12.7	141	0.00392	0.194	1.33e-05	0.00233	48.1
10072811	2900	151	2760	70.5	0.0012	11.9	150	0.00401	0.21	1.33e-05	0.00233	48.1



10067124	2030	112	1920	49.3	0.00 0903	7.56	120	0.00 298	0.178	1.33e -05	0.00 233	48.1
10067200	2170	119	2050	52.5	0.00 0956	7.92	125	0.00 312	0.183	1.33e -05	0.00 233	48.1
10011892	2780	143	2650	67.8	0.001 19	12.4	147	0.00 403	0.21	1.33e -05	0.00 233	48.1

Mix Designs: 15 to 20 MPa

Table 13: Total life cycle (across modules in scope) impact results for All declared products, assuming the geometric mean point values on a per 1 m3 of concrete basis.

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	44.2	0.145	282	2.65e-05	0.663	0.00117	1860
Maximum	51.6	0.159	372	3.56e-05	0.755	0.00156	2490
Mean	47.8	0.151	321	3.03e-05	0.709	0.00134	2120
Median	47.5	0.15	310	2.88e-05	0.71	0.00129	2020
10067219	44.2	0.145	282	2.65e-05	0.663	0.00117	1860
10067201	47.5	0.15	310	2.88e-05	0.71	0.00129	2020
10032165	51.6	0.159	372	3.56e-05	0.755	0.00156	2490

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFH W	CBW C	CW WC	CHW	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2090	114	1980	51.1	0.00 0944	7.86	122	0.003 06	0.183	1.33e -05	0.002 33	48.1
Maximum	2800	144	2640	67.7	0.001 2	11.8	146	0.003 98	0.21	1.33e -05	0.002 33	48.1
Mean	2390	128	2250	57.9	0.001 05	9.2	132	0.003 42	0.192	1.33e -05	0.002 33	48.1
Median	2270	127	2140	54.9	0.00 0997	7.93	128	0.003 21	0.183	1.33e -05	0.002 33	48.1
10067219	2090	114	1980	51.1	0.00 0944	7.93	122	0.003 06	0.183	1.33e -05	0.002 33	48.1
10067201	2270	127	2140	54.9	0.00 0997	7.86	128	0.003 21	0.183	1.33e -05	0.002 33	48.1
10032165	2800	144	2640	67.7	0.001 2	11.8	146	0.003 98	0.21	1.33e -05	0.002 33	48.1



Mix Designs: 21 to 25 MPa

Table 14: Total life cycle (across modules in scope) impact results for All declared products, 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	48.2	0.15	308	2.85e-05	0.724	0.00129	2000
Maximum	64.1	0.175	441	3.97e-05	0.947	0.00186	2780
Mean	55.7	0.162	375	3.43e-05	0.826	0.00158	2400
Median	55.1	0.161	369	3.37e-05	0.818	0.00155	2360
10066981	48.2	0.15	308	2.85e-05	0.724	0.00129	2000
10073458	51.4	0.156	337	3.14e-05	0.767	0.00141	2200
10060245	55.1	0.161	369	3.37e-05	0.818	0.00155	2360
10029084	58.5	0.167	404	3.65e-05	0.864	0.0017	2560
10072702	64.1	0.175	441	3.97e-05	0.947	0.00186	2780
10011050	50.3	0.154	331	3.08e-05	0.751	0.00138	2160
10048467	53	0.159	359	3.33e-05	0.786	0.0015	2330
10041261	57.4	0.165	392	3.57e-05	0.849	0.00165	2500
10072802	63.1	0.173	437	3.9e-05	0.931	0.00184	2730

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NR _R	RR	WD _P	LFW	LFHW	CBW _C	CWW _C	CHW	CNH _W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m ³	m ³	kg waste	kg waste	m ³	m ³	kg	kg
Minimum	2250	127	2110	54.6	0.00101	7.18	127	0.00316	0.172	1.33e-05	0.00233	48.1
Maximum	3140	183	2940	75.9	0.00133	8.87	155	0.004	0.215	1.33e-05	0.00233	48.1
Mean	2710	154	2550	65.6	0.00119	7.97	142	0.00361	0.194	1.33e-05	0.00233	48.1
Median	2670	151	2520	64.6	0.00117	7.89	140	0.00361	0.194	1.33e-05	0.00233	48.1
10066981	2250	127	2110	54.6	0.00101	7.27	127	0.00316	0.172	1.33e-05	0.00233	48.1
10073458	2470	139	2330	59.9	0.00111	8.42	135	0.00346	0.189	1.33e-05	0.00233	48.1
10060245	2670	151	2520	64.6	0.00117	7.82	140	0.00356	0.189	1.33e-05	0.00233	48.1
10029084	2890	167	2730	69.8	0.00126	7.89	148	0.00375	0.215	1.33e-05	0.00233	48.1
10072702	3140	183	2940	75.9	0.00133	7.89	155	0.004	0.194	1.33e-05	0.00233	48.1



10011050	2430	136	2300	58.8	0.00108	8.24	133	0.00339	0.189	1.33e-05	0.00233	48.1
10048467	2630	145	2480	64	0.00115	8.87	140	0.00361	0.194	1.33e-05	0.00233	48.1
10041261	2820	160	2650	68.2	0.00123	8.15	146	0.00372	0.194	1.33e-05	0.00233	48.1
10072802	3100	182	2900	74.5	0.00133	7.18	153	0.00386	0.21	1.33e-05	0.00233	48.1

Mix Designs: 26 to 30 MPa

Table 15: Total life cycle (across modules in scope) impact results for All declared products, 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	52.5	0.157	348	3.21e-05	0.781	0.00146	2250
Maximum	70.5	0.184	494	4.34e-05	1.04	0.00208	3040
Mean	60.4	0.169	414	3.72e-05	0.894	0.00174	2600
Median	59.2	0.168	409	3.71e-05	0.874	0.00172	2590
10011079	52.5	0.157	348	3.21e-05	0.781	0.00146	2250
10068980	55.7	0.162	374	3.37e-05	0.827	0.00157	2360
10010699	59.2	0.168	409	3.71e-05	0.874	0.00172	2590
10010840	64.2	0.175	443	3.96e-05	0.947	0.00186	2770
10062076	70.5	0.184	494	4.34e-05	1.04	0.00208	3040

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNH
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m ³	m ³	kg waste	kg waste	m ³	m ³	kg	kg
Minimum	2530	143	2380	61.6	0.00114	6.79	137	0.00348	0.189	1.33e-05	0.00233	48.1
Maximum	3450	205	3230	82.7	0.00143	8.11	164	0.00415	0.205	1.33e-05	0.00233	48.1
Mean	2940	171	2760	71	0.00127	7.47	149	0.00377	0.193	1.33e-05	0.00233	48.1
Median	2930	168	2750	70.7	0.00129	7.38	149	0.00381	0.189	1.33e-05	0.00233	48.1
10011079	2530	143	2380	61.6	0.00114	8.11	137	0.00348	0.189	1.33e-05	0.00233	48.1
10068980	2670	156	2500	64.7	0.00114	6.97	140	0.00348	0.194	1.33e-05	0.00233	48.1



10010699	2930	168	2750	70.7	0.00129	8.08	149	0.00381	0.205	1.33e-05	0.00233	48.1
10010840	3130	185	2950	75.5	0.00136	7.38	155	0.00394	0.189	1.33e-05	0.00233	48.1
10062076	3450	205	3230	82.7	0.00143	6.79	164	0.00415	0.189	1.33e-05	0.00233	48.1

Mix Designs: 31 to 35 MPa

Table 16: Total life cycle (across modules in scope) impact results for All declared products, 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	54.6	0.161	365	3.35e-05	0.812	0.00153	2350
Maximum	69.3	0.183	493	4.38e-05	1.02	0.00208	3060
Mean	61.4	0.171	425	3.83e-05	0.906	0.00179	2680
Median	60.4	0.17	416	3.76e-05	0.891	0.00175	2640
10041259	54.6	0.161	365	3.35e-05	0.812	0.00153	2350
10045331	59.4	0.168	411	3.74e-05	0.876	0.00173	2620
10065388	67	0.18	475	4.23e-05	0.983	0.002	2960
10041258	56.7	0.164	383	3.49e-05	0.842	0.00161	2440
10072763	61.3	0.171	422	3.79e-05	0.906	0.00177	2650
10067191	69.3	0.183	493	4.38e-05	1.02	0.00208	3060

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFH W	CBW C	CW WC	CHW	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2640	149	2490	64	0.00114	7.61	140	0.00356	0.189	1.33e-05	0.00233	48.1
Maximum	3480	203	3260	83.5	0.00148	8.48	166	0.00425	0.21	1.33e-05	0.00233	48.1
Mean	3030	174	2850	73.2	0.0013	7.93	152	0.00388	0.196	1.33e-05	0.00233	48.1
Median	2980	171	2800	72.2	0.00128	7.84	150	0.00385	0.194	1.33e-05	0.00233	48.1
10041259	2640	149	2490	64	0.00114	7.97	140	0.00356	0.189	1.33e-05	0.00233	48.1
10045331	2950	167	2780	71.8	0.00128	8.48	150	0.00387	0.194	1.33e-05	0.00233	48.1
10065388	3340	196	3150	80.6	0.00145	7.84	162	0.00414	0.21	1.33e-05	0.00233	48.1



10041258	2760	157	2590	66.8	0.0012	7.84	143	0.00365	0.189	1.33e-05	0.00233	48.1
10072763	3000	175	2820	72.7	0.00128	7.61	151	0.00383	0.194	1.33e-05	0.00233	48.1
10067191	3480	203	3260	83.5	0.00148	7.85	166	0.00425	0.2	1.33e-05	0.00233	48.1

Mix Designs: 36 to 40 MPa

Table 17: Total life cycle (across modules in scope) impact results for All declared products, 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	58.8	0.167	400	3.62e-05	0.872	0.00168	2530
Maximum	66.2	0.178	460	4.08e-05	0.977	0.00194	2860
Mean	62.5	0.172	430	3.85e-05	0.924	0.00181	2700
Median	62.5	0.172	430	3.85e-05	0.924	0.00181	2700
10058499	58.8	0.167	400	3.62e-05	0.872	0.00168	2530
10062563	66.2	0.178	460	4.08e-05	0.977	0.00194	2860

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFH W	CBW C	CW WC	CHW	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2860	166	2690	68.9	0.00125	7.12	147	0.00372	0.189	1.33e-05	0.00233	48.1
Maximum	3240	190	3040	77.8	0.00144	7.71	158	0.004	0.189	1.33e-05	0.00233	48.1
Mean	3050	178	2860	73.4	0.00134	7.42	152	0.00386	0.189	1.33e-05	0.00233	48.1
Median	3050	178	2860	73.4	0.00134	7.42	152	0.00386	0.189	1.33e-05	0.00233	48.1
10058499	2860	166	2690	68.9	0.00125	7.71	147	0.00372	0.189	1.33e-05	0.00233	48.1
10062563	3240	190	3040	77.8	0.00144	7.12	158	0.004	0.189	1.33e-05	0.00233	48.1



Mix Designs: 41 to 45 MPa

Table 18: Total life cycle (across modules in scope) impact results for All declared products, 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	63.4	0.174	435	3.91e-05	0.936	0.00183	2730
Maximum	72.6	0.188	512	4.49e-05	1.07	0.00216	3140
Mean	67.2	0.18	469	4.17e-05	0.992	0.00198	2920
Median	66.5	0.178	464	4.15e-05	0.98	0.00196	2900
10048460	63.4	0.174	435	3.91e-05	0.936	0.00183	2730
10027316	66.9	0.179	470	4.18e-05	0.985	0.00198	2920
10048322	72.6	0.188	512	4.49e-05	1.07	0.00216	3140
10062291	66.1	0.178	459	4.11e-05	0.975	0.00194	2870

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFH W	CBW C	CW WC	CHW	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m ³	m ³	kg waste	kg waste	m ³	m ³	kg	kg
Minimum	3080	181	2910	74.6	0.00134	6.85	154	0.00393	0.173	1.33e-05	0.00233	48.1
Maximum	3560	214	3340	85.5	0.00154	7.71	168	0.00427	0.194	1.33e-05	0.00233	48.1
Mean	3300	195	3110	79.5	0.00141	7.44	160	0.00409	0.182	1.33e-05	0.00233	48.1
Median	3280	192	3090	79	0.00138	7.6	160	0.00408	0.181	1.33e-05	0.00233	48.1
10048460	3080	181	2910	74.6	0.00134	7.65	154	0.00393	0.173	1.33e-05	0.00233	48.1
10027316	3310	194	3110	79.6	0.00142	7.55	161	0.00409	0.194	1.33e-05	0.00233	48.1
10048322	3560	214	3340	85.5	0.00154	6.85	168	0.00427	0.189	1.33e-05	0.00233	48.1
10062291	3240	190	3070	78.4	0.00135	7.71	159	0.00407	0.173	1.33e-05	0.00233	48.1



Mix Designs: 46 to 50 MPa

Table 19: Total life cycle (across modules in scope) impact results for All declared products, 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	65.2	0.177	452	4.02e-05	0.962	0.0019	2810
Maximum	80	0.199	574	5.01e-05	1.17	0.00243	3500
Mean	70.3	0.184	496	4.38e-05	1.03	0.00209	3060
Median	68	0.181	479	4.26e-05	0.998	0.00202	2980
10052003	65.7	0.178	463	4.15e-05	0.967	0.00195	2900
10052062	65.2	0.177	452	4.02e-05	0.962	0.0019	2810
10049785	70.2	0.184	495	4.36e-05	1.03	0.00208	3050
10072161	80	0.199	574	5.01e-05	1.17	0.00243	3500

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFH W	CBW C	CW WC	CHW	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m ³	m ³	kg waste	kg waste	m ³	m ³	kg	kg
Minimum	3190	187	3000	76.9	0.00135	6.96	157	0.00397	0.178	1.33e-05	0.00233	48.1
Maximum	3970	238	3740	95.2	0.00165	8.08	181	0.00464	0.194	1.33e-05	0.00233	48.1
Mean	3480	205	3270	83.7	0.00147	7.36	166	0.00422	0.189	1.33e-05	0.00233	48.1
Median	3370	198	3180	81.3	0.00144	7.19	162	0.00414	0.192	1.33e-05	0.00233	48.1
10052003	3280	189	3100	79.2	0.00142	8.08	160	0.00411	0.194	1.33e-05	0.00233	48.1
10052062	3190	187	3000	76.9	0.00135	7.32	157	0.00397	0.189	1.33e-05	0.00233	48.1
10049785	3460	206	3250	83.4	0.00145	7.06	165	0.00418	0.194	1.33e-05	0.00233	48.1
10072161	3970	238	3740	95.2	0.00165	6.96	181	0.00464	0.178	1.33e-05	0.00233	48.1



Mix Designs: 56 to 60 MPa

Table 20: **Total life cycle (across modules in scope) impact results for All declared products, 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	74.2	0.19	526	4.63e-05	1.09	0.00222	3240
Maximum	79.4	0.198	567	4.92e-05	1.16	0.00239	3440
Mean	76.8	0.194	546	4.78e-05	1.12	0.00231	3340
Median	76.8	0.194	546	4.78e-05	1.12	0.00231	3340
10072640	79.4	0.198	567	4.92e-05	1.16	0.00239	3440
10049790	74.2	0.19	526	4.63e-05	1.09	0.00222	3240

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFH W	CBW C	CW WC	CHW	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m ³	m ³	kg waste	kg waste	m ³	m ³	kg	kg
Minimum	3670	217	3450	88.5	0.00157	6.25	172	0.00439	0.178	1.33e-05	0.00233	48.1
Maximum	3920	237	3690	93.6	0.00166	7.15	179	0.00451	0.194	1.33e-05	0.00233	48.1
Mean	3800	227	3570	91	0.00162	6.7	176	0.00445	0.186	1.33e-05	0.00233	48.1
Median	3800	227	3570	91	0.00162	6.7	176	0.00445	0.186	1.33e-05	0.00233	48.1
10072640	3920	237	3690	93.6	0.00166	6.25	179	0.00451	0.194	1.33e-05	0.00233	48.1
10049790	3670	217	3450	88.5	0.00157	7.15	172	0.00439	0.178	1.33e-05	0.00233	48.1

ADDITIONAL ENVIRONMENTAL INFO

No regulated substances of very high concern are utilized on site.

The PCR allows for the grouping of similar products. Examples of grouping for concrete products include performance categories of compressive strength and high early strength, material characteristics of lightweight concrete, and production categories of ready-mix and central mix. Alternately, if a single value is chosen for each impact category for all products, the value reported should be the highest impact within the range of variation; therefore, the EPD would report the highest single value for each impact category amongst all of the products or plants included in the average EPD analysis." (PCR for Concrete v2.1)



All the ready-mix concrete products manufactured at the plant are listed below. A complete LCA with resulting impacts for the study was performed on all highlighted mixes. The non-highlighted mixes listed below are grouped by characteristics and then the amount of cement. The highest value for the GWP for each mix that was not part of the LCA but is within the 10% range is taken from the LCA mix as part of the study. The table outlines the GWP for all mixes produced at this plant as allowed by the PCR.

Table 21: **Mix Designs 0 to 15 MPa**

Mix	GWP	MPa
10062890		2
10011196		3,9
10047801	389	4
10072770	389	4
10064056	551	4,1
10011208	471	4,1
10011201	471	4,1
10051184	521	4,2
10074757	521	4,2
10011455	534	4,3
10073454	534	4,3
10011451	414	4,3
10065278	378	4,5
10062841	378	4,5
10034430	378	4,5
10011461	432	4,5
10011462	432	4,5
10072724	432	4,5
10073492	432	4,5
10042828	432	4,5
10051183	432	4,5
10062840	432	4,5
10072722	432	4,5
10011463	532	4,5
10072723	532	4,5
10064058	592	4,5
10075052	592	4,8
10033497	567	5
10067129	275	10,5
10067123	256	10,5
10074596	256	10,5
10010904	256	10,5
10024091	256	10,5
10010907	256	10,5
10072676	256	10,5
10075112	256	10,5
10075113	256	10,5



10011831	256	10,5
10045441	340	10,5
10012294	391	12,5
10072811	391	12,5
10067124	274	14
10067206	274	14
10048440	274	14
10067200	292	14
10010908	292	14
10010916	292	14
10072677	292	14
10012342	292	14
10011980	292	14
10011892	369	14
10075159	369	14

Table 22: Mix Designs 16 to 20 MPa

Mix	GWP	MPa
10067201	310	17,5
10067219	282	17,5
10067125	310	17,5
10010957	310	17,5
10010961	310	17,5
10072689	310	17,5
10034324	310	17,5
10012383	310	17,5
10065299	310	17,5
10075270	310	17,5
10074620	310	17,5
10074621	310	17,5
10032165	372	17,5

Table 23: Mix Designs 21 to 25 MPa

Mix	GWP	MPa
10069029	337	21
10010993	337	21
10010824	337	21
10010826	337	21
10072700	337	21
10048463	337	21
10069025	337	21



10073456	337	21
10048446	337	21
10048447	337	21
10073458	337	21
10010971	337	21
10010974	337	21
10012862	337	21
10072701	337	21
10074597	337	21
10011007	337	21
10012718	337	21
10045184	337	21
10072678	337	21
10052878	337	21
10011158	337	21
10072187	337	21
10011168	337	21
10048838	337	21
10018317	337	21
10049797	337	21
10054062	337	21
10069902	337	21
10072186	337	21
10011473	337	21
10050605	337	21
10011712	337	21
10068955	337	21
10068979	337	21
10011713	337	21
10068956	337	21
10068970	337	21
10062781	337	21
10062783	337	21
10053027	359	24,5
10027110	359	24,5
10048466	359	24,5
10048467	359	24,5
10073459	359	24,5
10048450	359	24,5
10062929	359	24,5
10073500	359	24,5
10011050	331	24,5
10011068	331	24,5



10044044	331	24,5
10073453	331	24,5
10011161	331	24,5
10068972	331	24,5
10068975	331	24,5
10029083	331	24,5
10011175	331	24,5
10041255	331	24,5
10068986	331	24,5
10041261	392	24,5
10068981	392	24,5
10034861	392	24,5
10051947	392	24,5
10010830	392	24,5
10069123	392	24,5
10034872	392	24,5
10072802	437	24,5

Table 24: Mix Designs 26 to 30 MPa

Mix	GWP	MPa
10048470	348	28
10048452	348	28
10048453	348	28
10064712	348	28
10064765	348	28
10074598	348	28
10074680	348	28
10069980	348	28
10010995	348	28
10011073	348	28
10011074	348	28
10041260	348	28
10072709	348	28
10011078	348	28
10011079	348	28
10011093	348	28
10044417	348	28
10072704	348	28
10062705	348	28
10049203	348	28
10011143	348	28
10018504	348	28



10062745	348	28
10010699	409	28
10044630	409	28
10048790	409	28
10063709	409	28
10072430	409	28
10010841	409	28
10057307	409	28
10072711	409	28
10072715	409	28
10010844	409	28
10049872	409	28
10056283	409	28
10072706	409	28
10072708	409	28
10048469	409	28
10073501	409	28
10074607	409	28
10074681	409	28
10073502	409	28
10011069	409	28
10072713	409	28
10012719	409	28
10072707	409	28
10072760	409	28
10072761	409	28
10074599	409	28
10052887	409	28
10017778	409	28
10060244	409	28
10072188	409	28
10011178	409	28
10051941	409	28
10027860	409	28
10051940	409	28
10060249	409	28
10074436	409	28
10063765	409	28
10011477	409	28
10053885	409	28
10033740	409	28
10011719	409	28
10068957	409	28



10068976	409	28
10072718	409	28
10011772	409	28
10051949	409	28
10068980	374	28
10068982	374	28
10072717	374	28
10062706	374	28
10068642	374	28
10072721	374	28
10057678	374	28
10029081	374	28
10064013	374	28
10010835	374	28
10072710	374	28
10010840	443	28
10050078	443	28
10059470	443	28
10072705	443	28
10010843	443	28
10072560	443	28
10032353	443	28
10074648	443	28
10074177	443	28
10070924	443	28
10062076	494	28
10072089	494	28
10062799	494	28
10072617	494	28
10051180	494	28
10010759	494	28

Table 25: Mix Designs 31 to 35 MPa

Mix	GWP	MPa
10041259	365	31,5
10048456	365	31,5
10021898	365	31,5
10047430	365	31,5
10045331	411	31,5
10044144	411	31,5
10065388	475	31,5
10032252	475	31,5



10062359	475	31,5
10065068	475	31,5
10048475	422	35
10048457	422	35
10074630	422	35
10011136	422	35
10012884	422	35
10072763	422	35
10074756	422	35
10011145	422	35
10018040	422	35
10072762	422	35
10017770	422	35
10050073	422	35
10062754	422	35
10011778	422	35
10062293	422	35
10062300	422	35
10062294	422	35
10062780	422	35
10034867	422	35
10028491	422	35
10059062	422	35
10060247	422	35
10060283	422	35
10072140	422	35
10047081	422	35
10072720	422	35
10072719	422	35

Table 26: Mix Designs 36 to 40 MPa

Mix	GWP	MPa
10058499	400	38,5
10062563	460	38,5

Table 27: Mix Designs: 41 to 45 MPa

Mix	GWP	MPa
10035114	435	42
10052794	435	42
10047946	435	42



10052092	435	42
10048443	435	42
10073471	435	42
10048460	435	42
10073491	435	42
10074632	435	42
10011154	435	42
10041239	435	42
10072764	435	42
10072765	435	42
10027316	470	42
10062413	470	42
10063510	470	42
10063530	470	42
10048322	512	42
10073455	512	42
10074437	512	42
10062292	459	45
10062291	459	45

Table 28: Mix Designs 46 to 50 MPa

Mix	GWP	MPa
10052003	463	45,5
10072088	474	49
10072161	474	49
10049785	495	49
10072716	495	49
10052062	452	49
10061645	452	49

Table 29: Mix Designs 51 to 60 MPa

Mix	GWP	MPa
10043923	452	52,3
10072640		52,3
10049790	474	56



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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:

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Chapter: <http://epa.gov/climatechange/wycd/waste/downloads/fly-ash-chapter10-28-10.pdf>
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