Environmental Product Declaration

Environmental Product Declaration for ready mix concrete products produced by Holcim Colombia at their Nobsa facility in Boyacá, 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:	Holcim Colombia 7-45 Calle 13, Piso 12, Torre B, Ed. Teleport Business Park Bogotá, Colombia www.holcim.com.co
Program Operator:	Labeling Sustainability Address, 11670 W Sunset Blvd. City, State, Los Angeles, CA www.labelinsustainability.com/
Product Category Rule:	Core PCR: ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services SubPCR: NSF International (March 2020). Product Category Rul (PCR) for Environmental Product Declarations (EPD) PCR for Concrete, v2.1 Sub PCR Program Operator: NSF International Sub-category PCR review was conducted by: Thomas P. Gloria, Ph. D. of Industrial Ecology Consultants: 35 Bracebridge, Rd., Newton, MA 02459-1728, t.gloria@industrial-ecology.com. Dr. Michael Overcash of Environmental Clarity: 2908 Chipmunk Lane, Raleigh, NC 27607-3117, mrovercash@earthlink.net. Mr. Bill Stough of Sustainable Research Group: PO Box 1684, Grand Rapids, MI 49501-1684, bstough@sustainableresearchgroup.com. Mr. Jack Geilbig, EcoForm: 2624 Abelia Way, Suite 611, Knoxville, TN 37931, jgeilbig@ecoform.com.
Independent LCA Reviewer and EPD Verifier:	This EPD was independently verified in accordance with ISO 14025 and ISO 21930. The life cycle assessment was independently reviewed in accordance ISO 14044 and the referenced PCR. Independent verification of the declaration, according to ISO 14025:2006 Internal ☐ ; External X Third Party Verifier Geoffrey Guest, Certified 3rd Party Verifier under the International EPD Program (www.environdec.com), CSA Group (www.csaregistries.ca)
Date of Issue:	30 April 2023
Period of Validity:	5 years; valid until 29 April 2028
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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 72 concrete mixes manufactured at the Holcim Colombia, Nobsa concrete facility in Boyacá, 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	H2O to cement ratio
1	10062750	1 MPa 28d strength ready mix concrete.	Ready Mix	1.00	1.212121
2	10071837	2.45 MPa 28d strength ready mix concrete.	Ready Mix	2.45	1.076923
3	10065079	3 MPa 28d strength ready mix concrete.	Ready Mix	3.00	1.081081
4	10010951	3.2 MPa 28d strength ready mix concrete.	Ready Mix	3.20	0.567766
5	10057014	3.5 MPa 28d strength ready mix concrete.	Ready Mix	3.50	0.495208
6	10057085	3.8 MPa 28d strength ready mix concrete.	Ready Mix	3.80	0.487421
7	10069138	3.8 MPa 28d strength ready mix concrete.	Ready Mix	3.80	0.446927
8	10069136	3.8 MPa 28d strength ready mix concrete.	Ready Mix	3.80	0.378251
9	10058291	3.9 MPa 28d strength ready mix concrete.	Ready Mix	3.90	0.495208
10	10058264	3.9 MPa 28d strength ready mix concrete.	Ready Mix	3.90	0.451031
11	10058262	3.9 MPa 28d strength ready mix concrete.	Ready Mix	3.90	0.327696
12	10048564	4 MPa 28d strength ready mix concrete.	Ready Mix	4.00	0.458580
13	10069891	4 MPa 28d strength ready mix concrete.	Ready Mix	4.00	0.334728
14	10010938	4.1 MPa 28d strength ready mix concrete.	Ready Mix	4.10	0.445402
15	10011117	4.1 MPa 28d strength ready mix concrete.	Ready Mix	4.10	0.439698
16	10011110	4.1 MPa 28d strength ready mix concrete.	Ready Mix	4.10	0.345982

17	10056668	4.1 MPa 28d strength ready mix concrete.	Ready Mix	4.10	0.314402
18	10073555	4.2 MPa 28d strength ready mix concrete.	Ready Mix	4.20	0.421196
19	10032559	4.2 MPa 28d strength ready mix concrete.	Ready Mix	4.20	0.379902
20	10011176	4.2 MPa 28d strength ready mix concrete.	Ready Mix	4.20	0.331197
21	10010942	4.3 MPa 28d strength ready mix concrete.	Ready Mix	4.30	0.410053
22	10010944	4.5 MPa 28d strength ready mix concrete.	Ready Mix	4.50	0.375303
23	10052039	4.5 MPa 28d strength ready mix concrete.	Ready Mix	4.50	0.293561
24	10069948	4.9 MPa 28d strength ready mix concrete.	Ready Mix	4.90	0.288462
25	10062775	5 MPa 28d strength ready mix concrete.	Ready Mix	5.00	0.333333
26	10065078	7 MPa 28d strength ready mix concrete.	Ready Mix	7.00	0.851064
27	10067487	7 MPa 28d strength ready mix concrete.	Ready Mix	7.00	0.666667
28	10063545	10 MPa 28d strength ready mix concrete.	Ready Mix	10.00	0.630631
29	10010706	10.5 MPa 28d strength ready mix concrete.	Ready Mix	10.50	0.789474
30	10010802	10.5 MPa 28d strength ready mix concrete.	Ready Mix	10.50	0.628931
31	10030458	12.5 MPa 28d strength ready mix concrete.	Ready Mix	12.50	0.600601
32	10070381	12.5 MPa 28d strength ready mix concrete.	Ready Mix	12.50	0.620253
33	10066905	14 MPa 28d strength ready mix concrete.	Ready Mix	14.00	0.670927
34	10067171	14 MPa 28d strength ready mix concrete.	Ready Mix	14.00	0.574713

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
35	10063584	17.5 MPa 28d strength ready mix concrete.	Ready Mix	17.5	0.705882
36	10064749	17.5 MPa 28d strength ready mix concrete.	Ready Mix	17.5	0.636042
37	10066906	17.5 MPa 28d strength ready mix concrete.	Ready Mix	17.5	0.536193
38	10051788	20 MPa 28d strength ready mix concrete.	Ready Mix	20.0	0.625000

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
39	10035318	21 MPa 28d strength ready mix concrete.	Ready Mix	21.0	0.638783
40	10010726	21 MPa 28d strength ready mix concrete.	Ready Mix	21.0	0.594059
41	10047347	21 MPa 28d strength ready mix concrete.	Ready Mix	21.0	0.477612
42	10069681	21 MPa 28d strength ready mix concrete.	Ready Mix	21.0	0.500000
43	10010800	21 MPa 28d strength ready mix concrete.	Ready Mix	21.0	0.514706
44	10057309	21 MPa 28d strength ready mix concrete.	Ready Mix	21.0	0.352564
45	10071822	24 MPa 28d strength ready mix concrete.	Ready Mix	24.0	0.507463
46	10032560	24.5 MPa 28d strength ready mix concrete.	Ready Mix	24.5	0.586207
47	10054210	24.5 MPa 28d strength ready mix concrete.	Ready Mix	24.5	0.495356
48	10010775	24.5 MPa 28d strength ready mix concrete.	Ready Mix	24.5	0.446927
49	10010896	24.5 MPa 28d strength ready mix concrete.	Ready Mix	24.5	0.545906
50	10010774	24.5 MPa 28d strength ready mix concrete.	Ready Mix	24.5	0.349345

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	H2O to cement ratio
51	10059162	28 MPa 28d strength ready mix concrete.	Ready Mix	28	0.566038
52	10068613	28 MPa 28d strength ready mix concrete.	Ready Mix	28	0.524079
53	10064235	28 MPa 28d strength ready mix concrete.	Ready Mix	28	0.420918
54	10027961	28 MPa 28d strength ready mix concrete.	Ready Mix	28	0.508083
55	10010781	28 MPa 28d strength ready mix concrete.	Ready Mix	28	0.334728
56	10063412	28 MPa 28d strength ready mix concrete.	Ready Mix	28	0.322581

57	10059212	28 MPa 28d strength ready mix concrete.	Ready Mix	28	0.244094

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	H2O to cement ratio
58	10059163	31.5 MPa 28d strength ready mix concrete.	Ready Mix	31.5	0.529412
59	10010788	31.5 MPa 28d strength ready mix concrete.	Ready Mix	31.5	0.365297
60	10059164	35 MPa 28d strength ready mix concrete.	Ready Mix	35.0	0.497238
61	10028436	35 MPa 28d strength ready mix concrete.	Ready Mix	35.0	0.409429
62	10017291	35 MPa 28d strength ready mix concrete.	Ready Mix	35.0	0.446429
63	10010910	35 MPa 28d strength ready mix concrete.	Ready Mix	35.0	0.321285
64	10010789	35 MPa 28d strength ready mix concrete.	Ready Mix	35.0	0.291971
65	10070021	35 MPa 28d strength ready mix concrete.	Ready Mix	35.0	0.173228

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	H2O to cement ratio
66	10051789	40 MPa 28d strength ready mix concrete.	Ready Mix	40	0.435835

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
67	10059165	42 MPa 28d strength ready mix concrete.	Ready Mix	42	0.443350
68	10046068	42 MPa 28d strength ready mix concrete.	Ready Mix	42	0.345572

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
69	10053583	49 MPa 28d strength ready mix concrete.	Ready Mix	49	0.408163
70	10048089	49 MPa 28d strength ready mix concrete.	Ready Mix	49	0.308748

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 9: **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:

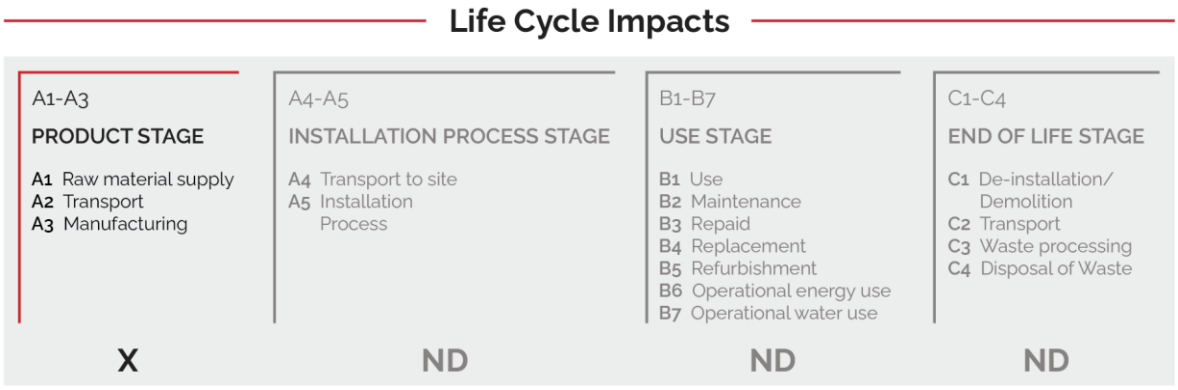

Figure 1: **General life cycle phases for consideration in a construction works system**

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 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 cement products and is not necessarily exhaustive.

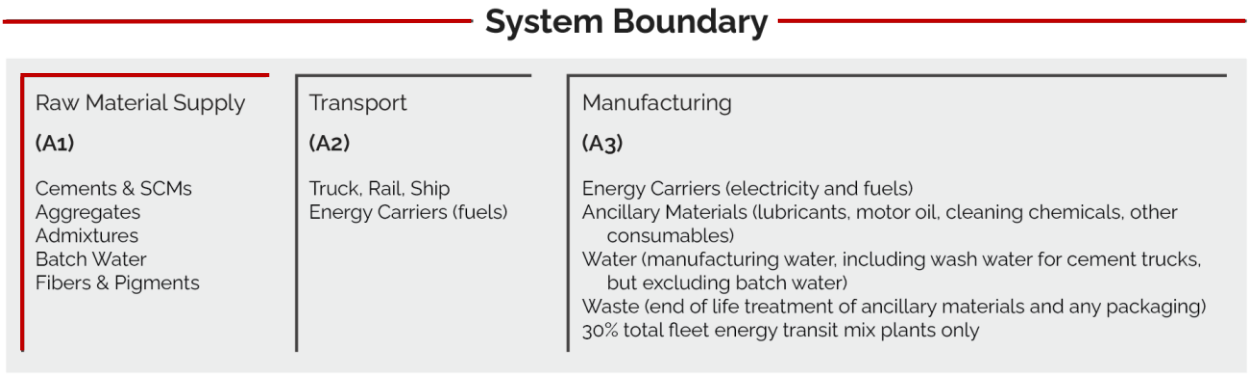

Figure 2: **General system inputs considered in the product system and categorized by modules in scope**

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 Colombia, is located at their Planta Nobsa 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

The following table summarizes the facility's (i.e. A3) electricity consumption and on-site generation or off-site contractual procurement (if applicable), process/space heating requirements, fuel inputs for on-site machinery, and waste generation.

Table 10: **Inputs required by facility from 2021-01-01 to 2021-12-31 (365 days) to produce 32,387.25 m3 of concrete**

Activity	Value	Units
Electricity consumption and on-site generation or off-site contractual procurement (if applicable)		
Gross grid electricity:	99,828	kWh
Fuel requirements for machinery		
Diesel	7,222.56	L
Waste generation		
Wash water	1,685.6	m3
Hazardous waste	703.6364	kg
Non-hazardous waste	2,077,091	kg
High-level radioactive waste	0	kg

No recovered on-site energy occurs at this facility.

Table 11: **Reused or recycled components/materials at the A3 facility site**

Component/material for re-use/recycling	Value	Units	Re-used/recycled on-site or off-site
Returned concrete	8.727273	m3	NA

The following statements explain how the above facility requirements/generation were derived:

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: (Ave. km to site)* 2 for return L diesel/km /(ave. m3 of concrete in a load) total concrete volume in m3 * 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 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 treatment/tap water/RoW/kg	ecoinvent v3.8	Valle del Cauca	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	Valle del Cauca	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	Valle del Cauca	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.

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 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	27.1	0.144	191	1.38e-05	0.429	0.000635	966
Maximum	70.1	0.206	493	3.51e-05	1.06	0.00188	2480
Mean	50.9	0.178	353	2.52e-05	0.778	0.00131	1780
Median	52	0.179	348	2.49e-05	0.799	0.0013	1760
10062750	27.1	0.144	191	1.38e-05	0.429	0.000635	966
10071837	30.2	0.149	216	1.55e-05	0.472	0.000735	1090
10065079	29.1	0.147	207	1.5e-05	0.457	0.000702	1050
10010951	45.4	0.169	281	1.99e-05	0.705	0.00104	1410
10057014	49.3	0.175	314	2.23e-05	0.76	0.00117	1580
10057085	49.8	0.176	318	2.26e-05	0.767	0.00119	1600
10069138	53.5	0.181	351	2.49e-05	0.82	0.00132	1770
10069136	59.8	0.191	405	2.88e-05	0.91	0.00154	2040
10058291	49.3	0.175	314	2.23e-05	0.76	0.00117	1580
10058264	56.1	0.185	376	2.67e-05	0.856	0.00142	1890
10058262	64.8	0.198	447	3.18e-05	0.981	0.0017	2250
10048564	51.7	0.178	335	2.37e-05	0.794	0.00125	1690
10069891	65.4	0.199	451	3.2e-05	0.99	0.00172	2270
10010938	52.4	0.18	343	2.44e-05	0.804	0.00129	1730
10011117	57.1	0.187	384	2.73e-05	0.87	0.00145	1930
10011110	62.4	0.194	426	3.03e-05	0.947	0.00162	2150

10056668	66.7	0.201	464	3.3e-05	1.01	0.00177	2340
10073555	54.5	0.183	360	2.55e-05	0.835	0.00135	1810
10032559	58.5	0.189	393	2.79e-05	0.891	0.00149	1980
10011176	64.3	0.197	443	3.15e-05	0.974	0.00169	2230
10010942	55.6	0.184	368	2.61e-05	0.85	0.00139	1850
10010944	59	0.189	397	2.82e-05	0.898	0.0015	2000
10052039	70.1	0.206	493	3.51e-05	1.06	0.00188	2480
10069948	68.1	0.203	485	3.45e-05	1.03	0.00185	2440
10062775	64	0.197	440	3.13e-05	0.97	0.00168	2220
10065078	34.2	0.155	249	1.8e-05	0.53	0.000869	1260
10067487	39.4	0.163	304	2.21e-05	0.604	0.00108	1550
10063545	41.3	0.167	330	2.4e-05	0.627	0.00118	1680
10010706	39	0.16	243	1.73e-05	0.61	0.000877	1220
10010802	40.2	0.165	319	2.33e-05	0.613	0.00113	1630
10030458	43.1	0.169	331	2.4e-05	0.657	0.00119	1680
10070381	46.5	0.174	379	2.71e-05	0.695	0.00138	1900
10066905	39.4	0.164	314	2.28e-05	0.599	0.00111	1600
10067171	44.5	0.171	344	2.49e-05	0.676	0.00124	1750

b) Inventory Metrics:

Indicator/LCI Metric	**TPE**	**RE**	**NRE**	**NRR**	**RR**	**WDP**	**LFW**	**LFHW**	**CBWC**	**CWWC**	**CHW**	**CNHW**
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m3**	**m3**	**kg waste**	**kg waste**	**m3**	**m3**	**kg**	**kg**
Minimum	1120	79.6	1040	26.3	0.000496	4.99	95.3	0.00125	0.158	5.2e-05	0.0217	64.1
Maximum	2890	220	2660	67.7	0.00125	15.7	146	0.00221	0.257	5.2e-05	0.0217	64.1
Mean	2070	157	1910	48.3	0.000911	8.08	123	0.00177	0.183	5.2e-05	0.0217	64.1
Median	2040	157	1880	47.7	0.000902	5.6	122	0.00176	0.166	5.2e-05	0.0217	64.1
10062750	1120	79.6	1040	26.3	0.000496	12.8	95.3	0.00125	0.21	5.2e-05	0.0217	64.1
10071837	1260	90.6	1170	29.5	0.000549	12.3	99.6	0.00133	0.22	5.2e-05	0.0217	64.1
10065079	1210	86.6	1120	28.4	0.000542	12.7	98.2	0.00131	0.21	5.2e-05	0.0217	64.1
10010951	1650	130	1510	38.4	0.000762	5.68	110	0.00152	0.163	5.2e-05	0.0217	64.1
10057014	1840	143	1710	43	0.000837	5.6	116	0.00163	0.163	5.2e-05	0.0217	64.1
10057085	1860	146	1720	43.6	0.000833	5.59	117	0.00164	0.163	5.2e-05	0.0217	64.1
10069138	2060	159	1890	48.1	0.00093	5.48	122	0.00175	0.168	5.2e-05	0.0217	64.1
10069136	2390	183	2200	55.4	0.00107	5.36	132	0.00193	0.168	5.2e-05	0.0217	64.1

10058291	1840	144	1690	42.8	0.00 0863	5.6	116	0.001 63	0.163	5.2e-05	0.021 7	64.1
10058264	2200	170	2030	51.4	0.00 0983	5.34	127	0.001 82	0.184	5.2e-05	0.021 7	64.1
10058262	2630	202	2430	61.1	0.001 13	5.3	138	0.00 207	0.163	5.2e-05	0.021 7	64.1
10048564	1980	153	1810	45.6	0.00 0872	5.55	120	0.001 7	0.163	5.2e-05	0.021 7	64.1
10069891	2670	204	2440	61.6	0.001 16	4.99	139	0.00 207	0.168	5.2e-05	0.021 7	64.1
10010938	2030	155	1850	47.2	0.00 0917	5.85	121	0.001 73	0.163	5.2e-05	0.021 7	64.1
10011117	2250	173	2080	52.2	0.00 0988	5.32	128	0.001 85	0.184	5.2e-05	0.021 7	64.1
10011110	2500	192	2300	58.3	0.001 09	5.34	135	0.00 2	0.163	5.2e-05	0.021 7	64.1
10056668	2710	209	2510	63.4	0.001 18	5.26	141	0.00 212	0.163	5.2e-05	0.021 7	64.1
10073555	2110	163	1940	49	0.00 0993	5.61	124	0.001 78	0.163	5.2e-05	0.021 7	64.1
10032559	2310	178	2120	53.4	0.001 03	5.42	129	0.001 89	0.163	5.2e-05	0.021 7	64.1
10011176	2600	200	2410	60.4	0.001 15	5.31	138	0.00 205	0.163	5.2e-05	0.021 7	64.1
10010942	2150	167	2000	50	0.00 0962	5.48	125	0.001 81	0.163	5.2e-05	0.021 7	64.1
10010944	2340	180	2150	54.1	0.001 05	5.41	130	0.001 9	0.163	5.2e-05	0.021 7	64.1
10052039	2890	220	2660	67.7	0.001 25	5.18	146	0.00 221	0.163	5.2e-05	0.021 7	64.1
10069948	2840	218	2620	65.9	0.001 24	5.15	145	0.00 217	0.158	5.2e-05	0.021 7	64.1
10062775	2570	198	2380	60.3	0.001 13	5.31	137	0.00 204	0.163	5.2e-05	0.021 7	64.1
10065078	1450	105	1360	34.1	0.00 0626	12.3	105	0.001 44	0.21	5.2e-05	0.021 7	64.1
10067487	1790	126	1660	41.7	0.00 0745	14.4	115	0.001 66	0.21	5.2e-05	0.021 7	64.1
10063545	1940	136	1800	45	0.00 0797	14.6	119	0.001 73	0.22	5.2e-05	0.021 7	64.1
10010706	1420	111	1320	33.3	0.00 0674	7.4	104	0.001 4	0.189	5.2e-05	0.021 7	64.1
10010802	1890	133	1750	43.6	0.00 0787	15.7	118	0.001 73	0.21	5.2e-05	0.021 7	64.1
10030458	1940	139	1800	45.3	0.00 081	13.6	119	0.001 74	0.21	5.2e-05	0.021 7	64.1
10070381	2190	159	2050	50.9	0.00 0886	11.3	127	0.001 79	0.257	5.2e-05	0.021 7	64.1
10066905	1840	130	1710	43	0.00 0784	14.8	117	0.001 68	0.22	5.2e-05	0.021 7	64.1
10067171	2020	144	1870	46.9	0.00 0845	13.8	122	0.001 79	0.21	5.2e-05	0.021 7	64.1

Mix Designs: 15 to 20 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 CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	41.7	0.164	266	1.89e-05	0.647	0.000967	1340
Maximum	45.5	0.173	364	2.64e-05	0.693	0.00132	1850
Mean	44.1	0.168	303	2.17e-05	0.678	0.00111	1530
Median	44.6	0.168	291	2.07e-05	0.686	0.00107	1470
10063584	41.7	0.164	266	1.89e-05	0.647	0.000967	1340
10064749	44.2	0.168	289	2.06e-05	0.683	0.00106	1460
10066906	45.5	0.173	364	2.64e-05	0.688	0.00132	1850
10051788	44.9	0.169	293	2.08e-05	0.693	0.00108	1480

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	1560	120	1440	36.2	0.000708	7.24	108	0.00148	0.189	5.2e-05	0.0217	64.1
Maximum	2150	151	1990	49.8	0.000875	14.6	125	0.00185	0.21	5.2e-05	0.0217	64.1
Mean	1780	134	1640	41.3	0.000782	9.15	114	0.00161	0.194	5.2e-05	0.0217	64.1
Median	1710	132	1580	39.6	0.000772	7.38	112	0.00156	0.189	5.2e-05	0.0217	64.1
10063584	1560	120	1440	36.2	0.000708	7.32	108	0.00148	0.189	5.2e-05	0.0217	64.1
10064749	1700	130	1570	39.3	0.000759	7.44	112	0.00155	0.189	5.2e-05	0.0217	64.1
10066906	2150	151	1990	49.8	0.000875	14.6	125	0.00185	0.21	5.2e-05	0.0217	64.1
10051788	1720	133	1580	40	0.000786	7.24	113	0.00157	0.189	5.2e-05	0.0217	64.1

Mix Designs: 21 to 25 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 CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	42.7	0.165	273	1.94e-05	0.663	0.000995	1370
Maximum	64.5	0.197	443	3.14e-05	0.976	0.00169	2480
Mean	52.2	0.18	356	2.54e-05	0.795	0.00135	1860
Median	52	0.18	342	2.48e-05	0.778	0.00134	1800
10035318	42.7	0.165	273	1.94e-05	0.663	0.000995	1370
10010726	46.2	0.171	306	2.17e-05	0.712	0.00113	1540
10047347	50	0.176	333	2.37e-05	0.768	0.00124	1680
10069681	52.7	0.181	361	2.57e-05	0.804	0.00135	1820
10010800	51.2	0.18	392	2.82e-05	0.772	0.00144	1980
10057309	64.5	0.197	443	3.14e-05	0.976	0.00169	2230
10071822	49.6	0.176	332	2.37e-05	0.762	0.00123	1680
10032560	52.8	0.182	329	2.47e-05	0.783	0.00147	2480
10054210	48.3	0.174	323	2.3e-05	0.742	0.00119	1630
10010775	52.9	0.18	352	2.5e-05	0.81	0.00132	1770
10010896	52.8	0.182	388	2.78e-05	0.8	0.00144	1960
10010774	62.7	0.195	435	3.09e-05	0.951	0.00165	2190

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	1600	124	1480	37.2	0.000733	4.82	109	0.00151	0.168	5.2e-05	0.0217	64.1
Maximum	2820	199	2670	67.2	0.00131	11.6	138	0.00204	0.231	5.2e-05	0.0217	64.1
Mean	2160	159	2000	50.3	0.000959	7.47	123	0.0018	0.184	5.2e-05	0.0217	64.1
Median	2100	154	1930	48.4	0.000934	7.28	120	0.00178	0.177	5.2e-05	0.0217	64.1
10035318	1600	124	1480	37.2	0.000733	7.41	109	0.00151	0.176	5.2e-05	0.0217	64.1
10010726	1800	137	1650	41.7	0.000795	7.37	115	0.00161	0.189	5.2e-05	0.0217	64.1
10047347	1960	149	1800	45.4	0.000868	7.13	119	0.00171	0.168	5.2e-05	0.0217	64.1
10069681	2130	161	1950	49	0.000931	7.09	124	0.00179	0.194	5.2e-05	0.0217	64.1

10010800	2310	167	2120	53.3	0.000945	11.6	130	0.00191	0.22	5.2e-05	0.0217	64.1
10057309	2580	199	2400	60.3	0.00111	4.82	138	0.00204	0.173	5.2e-05	0.0217	64.1
10071822	1950	149	1800	45.4	0.000908	7.22	119	0.0017	0.178	5.2e-05	0.0217	64.1
10032560	2820	151	2670	67.2	0.00131	7.34	117	0.00197	0.178	5.2e-05	0.0217	64.1
10054210	1900	144	1750	44.2	0.00085	7.8	118	0.00168	0.168	5.2e-05	0.0217	64.1
10010775	2060	158	1910	47.9	0.000937	6.32	122	0.00176	0.168	5.2e-05	0.0217	64.1
10010896	2270	168	2100	52.9	0.000966	9.58	129	0.00188	0.231	5.2e-05	0.0217	64.1
10010774	2550	196	2350	59.3	0.00115	5.92	136	0.00203	0.168	5.2e-05	0.0217	64.1

Mix Designs: 26 to 30 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	47.8	0.173	318	2.26e-05	0.735	0.00118	1600
Maximum	79.1	0.22	582	4.16e-05	1.18	0.00223	2940
Mean	60.4	0.192	426	3.04e-05	0.915	0.00161	2150
Median	55.6	0.186	413	2.96e-05	0.847	0.00154	2090
10059162	47.8	0.173	318	2.26e-05	0.735	0.00118	1600
10068613	51.3	0.178	347	2.47e-05	0.784	0.00129	1750
10064235	55.5	0.185	380	2.71e-05	0.847	0.00143	1920
10027961	55.6	0.186	413	2.96e-05	0.84	0.00154	2090
10010781	64.8	0.198	451	3.21e-05	0.98	0.00172	2270
10063412	69	0.205	491	3.49e-05	1.04	0.00187	2470
10059212	79.1	0.22	582	4.16e-05	1.18	0.00223	2940

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	1860	144	1720	43.5	0.000827	5	117	0.00165	0.163	5.2e-05	0.0217	64.1
Maximum	3430	256	3180	79	0.00146	9.63	161	0.00252	0.231	5.2e-05	0.0217	64.1
Mean	2500	189	2320	58.1	0.00111	6.84	135	0.002	0.185	5.2e-05	0.0217	64.1
Median	2430	179	2240	56.2	0.00109	6.83	133	0.00196	0.178	5.2e-05	0.0217	64.1
10059162	1860	144	1720	43.5	0.000827	7.16	117	0.00165	0.189	5.2e-05	0.0217	64.1
10068613	2030	155	1880	47.5	0.000914	6.86	122	0.00174	0.194	5.2e-05	0.0217	64.1
10064235	2230	171	2060	52	0.00101	6.83	127	0.00186	0.173	5.2e-05	0.0217	64.1
10027961	2430	179	2240	56.2	0.00109	9.63	133	0.00196	0.231	5.2e-05	0.0217	64.1
10010781	2660	202	2450	61.3	0.00119	5.78	139	0.00208	0.168	5.2e-05	0.0217	64.1
10063412	2870	218	2680	66.9	0.00127	5	146	0.00218	0.178	5.2e-05	0.0217	64.1
10059212	3430	256	3180	79	0.00146	6.6	161	0.00252	0.163	5.2e-05	0.0217	64.1

Mix Designs: 31 to 35 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	50	0.177	336	2.39e-05	0.766	0.00125	1690
Maximum	79.1	0.22	581	4.14e-05	1.18	0.00223	2930
Mean	62.2	0.195	435	3.1e-05	0.942	0.00165	2190
Median	60.6	0.192	422	3e-05	0.919	0.0016	2120
10059163	50	0.177	336	2.39e-05	0.766	0.00125	1690
10010788	61.3	0.193	418	2.97e-05	0.931	0.00159	2100
10059164	52.1	0.18	355	2.52e-05	0.796	0.00132	1790
10028436	56.7	0.186	389	2.77e-05	0.863	0.00146	1960
10017291	59.9	0.192	426	3.03e-05	0.906	0.0016	2140

10010910	66.6	0.201	468	3.33e-05	1.01	0.00178	2360
10010789	71.7	0.208	509	3.63e-05	1.08	0.00195	2570
10070021	79.1	0.22	581	4.14e-05	1.18	0.00223	2930

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	1970	151	1810	46	0.000884	5.38	120	0.00171	0.116	5.2e-05	0.0217	64.1
Maximum	3400	258	3140	78.7	0.00142	7.1	161	0.00249	0.21	5.2e-05	0.0217	64.1
Mean	2560	194	2350	59.3	0.0011	6.21	137	0.00203	0.173	5.2e-05	0.0217	64.1
Median	2480	188	2280	57.4	0.00108	6.25	134	0.00198	0.17	5.2e-05	0.0217	64.1
10059163	1970	151	1810	46	0.000884	7.1	120	0.00171	0.189	5.2e-05	0.0217	64.1
10010788	2460	190	2260	56.9	0.00108	5.4	134	0.00197	0.168	5.2e-05	0.0217	64.1
10059164	2070	160	1920	48.4	0.000911	7.04	123	0.00177	0.189	5.2e-05	0.0217	64.1
10028436	2290	174	2100	53.1	0.000972	6.68	129	0.00188	0.173	5.2e-05	0.0217	64.1
10017291	2510	187	2310	57.9	0.00108	6.81	135	0.00199	0.21	5.2e-05	0.0217	64.1
10010910	2750	209	2530	63.7	0.00119	5.82	142	0.00214	0.168	5.2e-05	0.0217	64.1
10010789	2990	227	2760	69.5	0.00127	5.42	149	0.00227	0.168	5.2e-05	0.0217	64.1
10070021	3400	258	3140	78.7	0.00142	5.38	161	0.00249	0.116	5.2e-05	0.0217	64.1

Mix Designs: 36 to 40 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 CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
10051789	57.1	0.187	397	2.83e-05	0.867	0.00149	2000

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**
10051789	2320	177	2160	54	0.00101	6.89	130	0.0019	0.189	5.2e-05	0.0217	64.1

Mix Designs: 41 to 45 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 CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	56.4	0.186	391	2.79e-05	0.858	0.00147	1970
Maximum	62.7	0.195	439	3.13e-05	0.95	0.00166	2210
Mean	59.6	0.19	415	2.96e-05	0.904	0.00156	2090
Median	59.6	0.19	415	2.96e-05	0.904	0.00156	2090
10059165	56.4	0.186	391	2.79e-05	0.858	0.00147	1970
10046068	62.7	0.195	439	3.13e-05	0.95	0.00166	2210

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	2290	174	2120	53.3	0.001	6.45	129	0.00189	0.168	5.2e-05	0.0217	64.1
Maximum	2570	197	2370	59.8	0.00114	6.92	137	0.00205	0.189	5.2e-05	0.0217	64.1
Mean	2430	186	2240	56.6	0.00107	6.68	133	0.00197	0.178	5.2e-05	0.0217	64.1
Median	2430	186	2240	56.6	0.00107	6.68	133	0.00197	0.178	5.2e-05	0.0217	64.1
10059165	2290	174	2120	53.3	0.001	6.92	129	0.00189	0.189	5.2e-05	0.0217	64.1
10046068	2570	197	2370	59.8	0.00114	6.45	137	0.00205	0.168	5.2e-05	0.0217	64.1

Mix Designs: 46 to 50 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 CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	59.8	0.191	420	2.99e-05	0.906	0.00158	2120
Maximum	73.7	0.212	538	3.84e-05	1.1	0.00206	2710
Mean	66.8	0.202	479	3.41e-05	1	0.00182	2420
Median	66.8	0.202	479	3.41e-05	1	0.00182	2420
10053583	59.8	0.191	420	2.99e-05	0.906	0.00158	2120
10048089	73.7	0.212	538	3.84e-05	1.1	0.00206	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	2460	187	2280	57.3	0.00103	6.32	134	0.00198	0.189	5.2e-05	0.0217	64.1
Maximum	3140	237	2920	73.5	0.00134	6.82	154	0.00236	0.189	5.2e-05	0.0217	64.1

Mean	2800	212	2600	65.4	0.00119	6.57	144	0.00217	0.189	5.2e-05	0.0217	64.1
Median	2800	212	2600	65.4	0.00119	6.57	144	0.00217	0.189	5.2e-05	0.0217	64.1
10053583	2460	187	2280	57.3	0.00103	6.82	134	0.00198	0.189	5.2e-05	0.0217	64.1
10048089	3140	237	2920	73.5	0.00134	6.32	154	0.00236	0.189	5.2e-05	0.0217	64.1

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.

Mix Designs: 0 to 15 MPa

Mix	GWP	MPa
10062750	191	1
10071837	216	2,45
10065079	207	3
10010951	281	3,2
10057014	314	3,5
10073588	314	3,5
10069138	351	3,8
10057085	351	3,8
10057532	351	3,8
10065200	351	3,8
10065427	351	3,8
10069136	351	3,8
10069137	351	3,8
10010939	314	3,9
10028157	314	3,9
10058291	314	3,9

10062861	314	3,9
10073690	314	3,9
10052596	376	3,9
10058263	376	3,9
10058155	376	3,9
10058264	376	3,9
10058262	447	3,9
10048564	335	4
10070686	335	4
10069891	451	4
10010938	343	4,1
10035615	343	4,1
10042832	343	4,1
10047471	343	4,1
10049922	343	4,1
10052156	343	4,1
10052190	343	4,1
10056651	343	4,1
10056790	343	4,1
10064961	343	4,1
10068534	343	4,1
10057311	426	4,1
10064492	426	4,1
10011110	426	4,1
10062989	426	4,1
10011117	426	4,1
10059963	426	4,1
10067624	426	4,1
10056668	464	4,1
10059514	464	4,1
10073555	363	4,2
10073556	363	4,2
10010941	363	4,2
10044388	363	4,2
10056691	363	4,2
10058218	393	4,2
10032559	393	4,2
10057503	393	4,2
10057504	393	4,2
10070035	393	4,2
10070359	443	4,2
10011176	443	4,2
10045017	443	4,2
10010942	368	4,3
10057273	368	4,3
10075320	368	4,3

10021060	397	4,5
10065440	397	4,5
10010944	397	4,5
10047087	397	4,5
10052100	397	4,5
10056232	397	4,5
10056702	397	4,5
10065441	397	4,5
10075321	397	4,5
10027517	493	4,5
10046925	493	4,5
10052039	493	4,5
10065429	493	4,5
10053024	493	4,5
10060233	493	4,5
10065428	493	4,5
10069948	485	4,9
10062775	440	5
10067487	304	7
10065078	304	7
10063545	330	10
10010704	243	10,5
10010706	243	10,5
10010802	319	10,5
10045441	319	10,5
10070380	331	12,5
10030458	331	12,5
10071124	331	12,5
10070381	379	12,5
10063921	379	14
10010709	379	14
10063844	379	14
10070025	379	14
10058762	379	14
10062137	379	14
10070534	379	14
10010707	379	14

Mix Designs: 16 to 20 MPa

Mix	GWP	MPa
10066935	289	17,5
10064748	289	17,5
10064749	289	17,5
10046883	289	17,5

10064747	289	17,5
10010710	289	17,5
10010715	289	17,5
10010716	289	17,5
10010717	289	17,5
10063584	289	17,5
10071904	364	17,5
10066906	364	17,5
10067111	364	17,5
10010805	364	17,5
10010806	364	17,5
10010799	364	17,5
10068117	364	17,5
10051788	293	20

Mix Designs: 21 to 25 MPa

Mix	GWP	MPa
10010726	273	21
10031531	273	21
10058029	273	21
10059139	273	21
10062523	273	21
10067563	273	21
10070622	273	21
10010728	273	21
10011170	273	21
10054079	273	21
10056186	273	21
10059167	273	21
10062522	273	21
10063922	273	21
10064081	273	21
10064236	273	21
10070685	273	21
10010719	273	21
10011930	273	21
10059130	273	21
10064088	273	21
10068631	273	21
10010724	273	21
10010725	273	21

10059160	273	21
10063211	273	21
10065442	273	21
10069934	273	21
10010694	273	21
10053179	273	21
10056031	273	21
10043218	273	21
10035318	273	21
10059256	273	21
10010766	273	21
10010767	273	21
10070007	273	21
10010769	273	21
10010770	273	21
10057294	273	21
10062980	273	21
10032439	273	21
10050625	273	21
10058392	273	21
10063217	273	21
10070471	273	21
10047324	273	21
10063923	273	21
10010718	273	21
10062486	273	21
10063213	273	21
10010723	273	21
10062483	273	21
10064089	273	21
10070164	273	21
10059024	273	21
10011072	273	21
10062565	273	21
10018393	273	21
10013009	273	21
10047347	273	21
10010691	273	21
10065507	273	21
10010693	273	21
10070420	273	21
10069681	273	21
10010790	273	21

10010857	273	21
10042791	273	21
10065094	273	21
10067570	392	21
10071251	392	21
10034863	392	21
10010761	392	21
10011083	392	21
10019065	392	21
10064232	392	21
10070006	392	21
10010763	392	21
10010764	392	21
10057293	392	21
10065265	392	21
10065285	392	21
10027310	392	21
10069840	392	21
10010895	392	21
10052583	392	21
10062691	392	21
10062692	392	21
10062092	392	21
10010807	392	21
10010808	392	21
10059283	392	21
10010800	392	21
10013117	443	21
10057309	443	21
10071822	332	24
10072326	329	24,5
10059168	329	24,5
10010736	329	24,5
10059161	329	24,5
10063210	329	24,5
10048434	329	24,5
10032560	329	24,5
10010776	352	24,5
10059001	352	24,5
10010775	352	24,5
10062770	352	24,5
10045355	352	24,5
10054210	352	24,5

10017961	352	24,5
10023233	352	24,5
10050353	352	24,5
10059140	352	24,5
10067304	352	24,5
10010922	352	24,5
10046880	352	24,5
10051081	352	24,5
10056404	352	24,5
10010730	352	24,5
10010731	352	24,5
10059133	352	24,5
10059888	352	24,5
10062487	352	24,5
10010729	352	24,5
10010734	352	24,5
10056185	352	24,5
10062484	352	24,5
10055851	352	24,5
10058898	352	24,5
10060948	352	24,5
10017848	352	24,5
10010696	352	24,5
10010791	352	24,5
10012429	352	24,5
10065096	352	24,5
10067703	352	24,5
10048357	352	24,5
10067566	388	24,5
10056101	388	24,5
10057086	388	24,5
10069929	388	24,5
10043912	388	24,5
10069928	388	24,5
10058984	388	24,5
10059481	388	24,5
10010896	388	24,5
10031582	388	24,5
10074863	388	24,5
10011045	388	24,5
10010885	435	24,5
10047667	435	24,5
10069927	435	24,5

10010774	435	24,5
10069926	435	24,5
10051211	435	24,5
10061151	435	24,5

Mix Designs: 26 to 30 MPa

Mix	GWP	MPa
10068485	435	28
10068613	435	28
10071146	435	28
10012149	435	28
10035381	435	28
10042836	435	28
10050430	435	28
10056300	435	28
10059141	435	28
10062525	435	28
10062988	435	28
10063216	435	28
10063685	435	28
10063688	435	28
10069936	435	28
10073529	435	28
10010747	435	28
10042835	435	28
10047385	435	28
10050210	435	28
10053487	435	28
10054078	435	28
10059169	435	28
10062524	435	28
10063581	435	28
10063925	435	28
10063926	435	28
10064082	435	28
10069937	435	28
10070390	435	28
10070470	435	28
10070901	435	28
10010741	435	28
10010742	435	28

10010870	435	28
10056786	435	28
10059134	435	28
10063214	435	28
10010740	435	28
10010746	435	28
10048534	435	28
10059162	435	28
10062485	435	28
10063215	435	28
10063845	435	28
10069935	435	28
10073525	435	28
10019800	435	28
10062566	435	28
10051940	435	28
10046313	435	28
10046034	435	28
10046036	435	28
10046037	435	28
10064415	435	28
10010698	435	28
10042688	435	28
10064417	435	28
10045993	435	28
10011483	435	28
10058710	435	28
10065095	435	28
10064631	435	28
10062420	413	28
10069399	413	28
10067561	413	28
10067564	413	28
10033911	413	28
10050059	413	28
10019290	413	28
10047384	413	28
10010782	413	28
10010976	413	28
10048999	413	28
10056420	413	28
10062956	413	28
10063684	413	28

10064234	413	28
10067818	413	28
10070742	413	28
10070932	413	28
10010784	413	28
10017018	413	28
10035588	413	28
10047294	413	28
10049278	413	28
10064630	413	28
10064833	413	28
10070741	413	28
10070931	413	28
10031751	413	28
10071231	413	28
10057298	413	28
10059586	413	28
10063582	413	28
10070896	413	28
10010745	413	28
10055852	413	28
10058927	413	28
10017476	413	28
10064235	413	28
10070219	413	28
10072131	413	28
10070899	413	28
10070898	413	28
10027961	413	28
10033740	413	28
10071213	413	28
10011040	413	28
10062173	413	28
10065283	491	28
10069677	491	28
10062418	491	28
10070029	491	28
10062345	491	28
10070027	491	28
10070028	491	28
10010778	491	28
10050218	491	28
10056435	491	28

10059611	491	28
10063412	491	28
10064233	491	28
10069521	491	28
10070740	491	28
10070935	491	28
10010780	491	28
10010781	491	28
10058070	491	28
10064499	491	28
10069599	491	28
10070121	491	28
10070738	491	28
10070933	491	28
10059877	491	28
10070026	491	28
10070301	491	28
10048355	491	28
10059212	582	28

Mix Designs: 31 to 35 MPa

Mix	GWP	MPa
10046927	336	31,5
10059142	336	31,5
10063126	336	31,5
10059170	336	31,5
10010748	336	31,5
10016951	336	31,5
10059135	336	31,5
10010749	336	31,5
10010750	336	31,5
10011127	336	31,5
10059163	336	31,5
10064801	336	31,5
10010788	418	31,5
10012850	418	31,5
10064239	418	31,5
10059171	355	35
10059164	355	35
10017291	426	35
10046914	426	35

10058031	426	35
10064802	426	35
10010989	426	35
10035359	426	35
10035718	426	35
10056657	426	35
10058032	426	35
10059143	426	35
10059585	426	35
10063683	426	35
10070535	426	35
10071144	426	35
10046888	426	35
10050916	426	35
10054698	426	35
10055658	426	35
10010751	426	35
10059136	426	35
10064230	426	35
10010754	426	35
10052070	426	35
10028436	426	35
10023335	426	35
10018801	426	35
10055572	426	35
10065097	426	35
10064291	509	35
10053780	509	35
10010789	509	35
10052014	509	35
10056621	509	35
10011026	509	35
10056853	509	35
10058906	509	35
10063682	509	35
10010910	509	35
10026991	509	35
10052068	509	35
10052847	509	35
10052896	509	35
10052846	509	35
10021915	509	35
10070021	581	35

10066824	581	35
10070120	581	35
10058176	581	35
10067326	581	35
10068837	581	35
10052067	581	35

Mix Designs: 36 to 40 MPa

Mix	GWP	MPa
10058040	397	40
10051789	397	40

Mix Designs: 41 to 45 MPa

Mix	GWP	MPa
10034945	391	42
10059271	391	42
10059172	391	42
10010878	391	42
10059137	391	42
10059165	391	42
10031839	439	42
10050163	439	42
10046068	439	42

Mix Designs: 46 to 50 MPa

Mix	GWP	MPa
10053583	420	49
10048089	538	49
10069945	538	49
10069946	538	49

Mix Designs: 250 to 300 MPa

Mix	GWP	MPa
10045359	538	280

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:

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