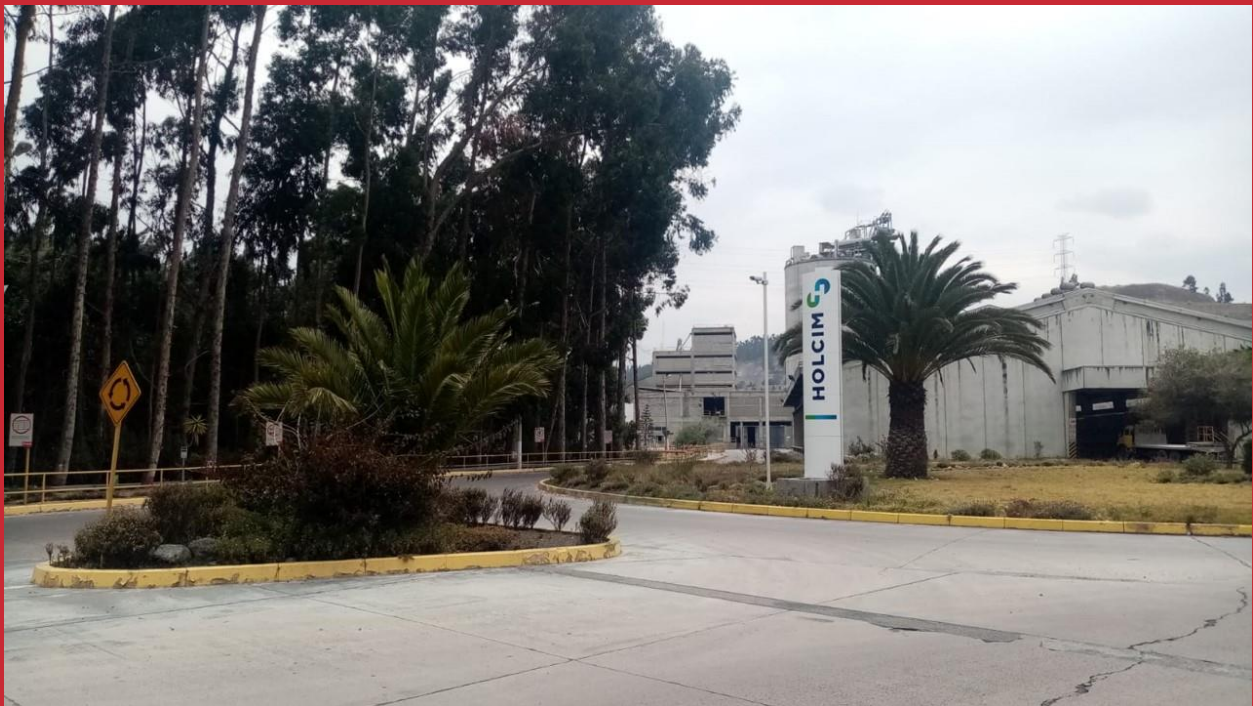


Environmental Product Declaration



**Environmental Product Declaration for cement products
produced by Holcim Ecuador at their Latacunga facility in
Latacunga, Ecuador**



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ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers cement products produced by Holcim Ecuador. Declared unit: 1 tonne of cement
Declaration Owner:	Holcim Ecuador
	444 S/N
	Av. Barcelona y José Rodríguez Bonin, Edif. El Caimán Piso 2, Guayaquil
	holcim.com.ec
Program Operator:	Labeling Sustainability
	11670 W Sunset Blvd.
	Los Angeles, CA
	http://labelingsustainability.com/
Product Category Rule:	Core PCR: ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services SubPCR: NSF International (March2020). Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPD) of Portland, Blended, Mansory, Mortar and Plastic (stucco) Cements, Valid through March 31, 2025.
	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 . Mr. Bill Stough, Sustainable Research Group: PO Box 1684, Grand Rapids, MI 49501-1684, bstough@sustainableresearchgroup.com . Mr. Jack Geilbig, EcoForm: 2624 Abelia War, Suite 611, Knoxville, TN 37931, jgeilbig@ecoform.com
Independent LCA Reviewer and EPD Verifier:	This EPD was independently verified in accordance with ISO 14025. 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 <input type="checkbox"/> ; External X
	Third Party Verifier Geoffrey Guest, Certified 3rd Party Verifier under the CSA group (www.csaregistrries.ca), Labeling Sustainability (www.labelingsustainability.com), P3Optima (www.P3Optima.com)
Date of Issue:	08 December 2022
Period of Validity:	5 years; valid until 09 December 2027
EPD Number:	939c5672-167c-492e-a679-3dfdab74d3dc



COMPANY DESCRIPTION

Holcim Ecuador is part of the international Holcim group, a leader in innovative and sustainable construction solutions. With more than 100 years of experience in the country producing cement, concrete, aggregates, and solutions for the construction market. As well as its subsidiary company, Geocycle reinforces the commitment to the circular economy through the co-processing of waste. Holcim Ecuador has extensive coverage in the national territory, with an integrated cement plant in Guayaquil, a cement grinding plant in Latacunga, eleven concrete plants in Guayaquil, Quito, Cuenca, Manabí, Machala, Quevedo and Ambato, mobile equipment concrete, 2 aggregate plants in Pifo and Daule, the latter being Loma Alta, the first plant with 52% women in its operations

Per EPD guidelines, carbon credits in any form are not allowed to be part of the calculations. For the Cement Maestro and MH Holcim Ecuador offsets 100% of their carbon emissions through forestry offsets. The emissions generated by Holcim Maestro cement are being offset in the Cerro Blanco Protected Forest, which is in Guayaquil - Salinas Km 16, Chongón Parish, Guayaquil Canton, Guayas Province. At X coordinates 609389.32 and Y 9758626.22. Holcim manage 6,072 hectares of native forest, annually the company supports financially to carry out conservation actions.

The forest contains a very wide biodiversity, it has more than 700 species of plants of which 20% are endemic to southwestern Ecuador, 75 species of mammals including the jaguar, howler monkeys and bats, 221 species of birds, 8 amphibian species, among others. (White Hill 2020). The data obtained indicate that the forest is capturing an average of 2.85 Ton CO₂/ha/year. Which has a typical or standard error of 0.12%. The coefficient of variation is 23.10% and with a sampling error it is 6.93%.

The offset total for Maestro cement is 100% therefore the total GWP of 364 kg CO₂eq/ton of cement is zero if offsets are allowed in reporting outside of this EPD.

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 Cement published by NSF (2020) and is a PCR in accordance with ISO 21930 for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements. EPDs for cements that follow other PCRs may not be comparable.; 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 Ecuador 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 Ecuador



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 Ecuador's license to operate in the community. The intended audience for this LCA report is Holcim Ecuador'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 is prepared for products classified as UN CPC Group 3744-Cement or CSI MasterFormat Division 03 30 00 Cast-in-Place Concrete .

This EPD is primary reported Holcim data from the reference year 2021. It reports on the six cement mixes produced at the Latacunga grinding plant, made from primarily limestone. These six cement mixes make up 100% of yearly production at the Latacunga grinding plant. Clinked is transported from the Guayaquil cement plant is used for the cement reported in this EPD.plants. This plant is a grinding operation and does not operate a kiln.

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.

CEMENT DESIGN SUMMARY

The following tables provide a list of the cement products considered in this EPD along with key performance parameters.

Table 1: Declared products with All declared products considered in this environmental product declaration

Mix#	Unique name/ID	Short description	Product type	Clinker content, wt%	Resistance @28 Days (MPa)
1	GU Cement	Hydraulic Cement with specified strength at 3 days	Ordinary Portland	55.8	30
2	HE Cement	High strength hydraulic cement with specified strength at 1 day	Ordinary Portland	86.7	42
3	MH Cement	Hydraulic cement with moderate heat of hydration with specified strength at 3 days	Ordinary Portland	50.1	22
4	HE/HS Cement	Hydraulic cement with high resistance to sulfates with specified strength at 1 day	Ordinary Portland	54.1	32
5	MS Cement	Non-structural cement with specified strength at 1 day	Ordinary Portland	79.9	40



CEMENT DESIGN COMPOSITION

The following figures provide mass breakdown (kg per functional unit) of the material composition of each cement design considered. Please note that the breakdown has been randomly altered and is therefore only an approximation; this manipulation is to ensure confidentiality.

Table 2 Cement composition

Product Components	Raw Material, weight%
Clinker	Proprietary
Mineral Additions (limestone and Pozzolana)	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 (ND= Not Defined)

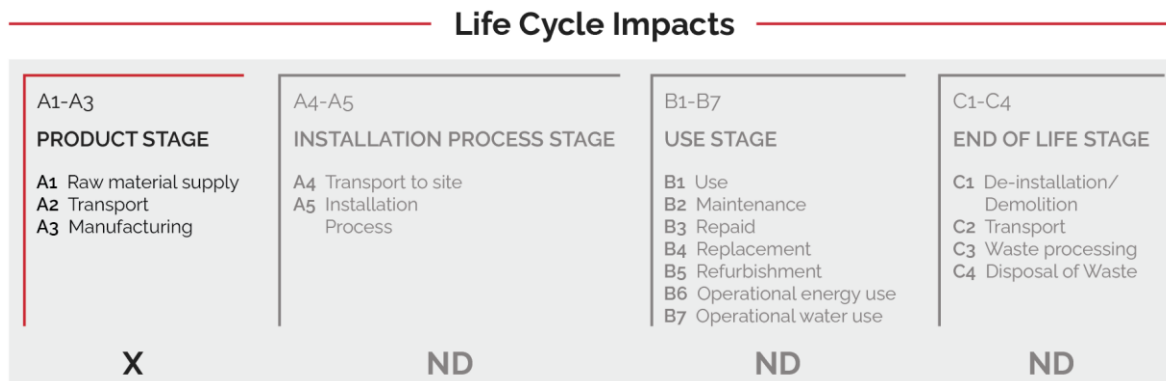


Figure 2: General life cycle phases for consideration in a construction works system

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.



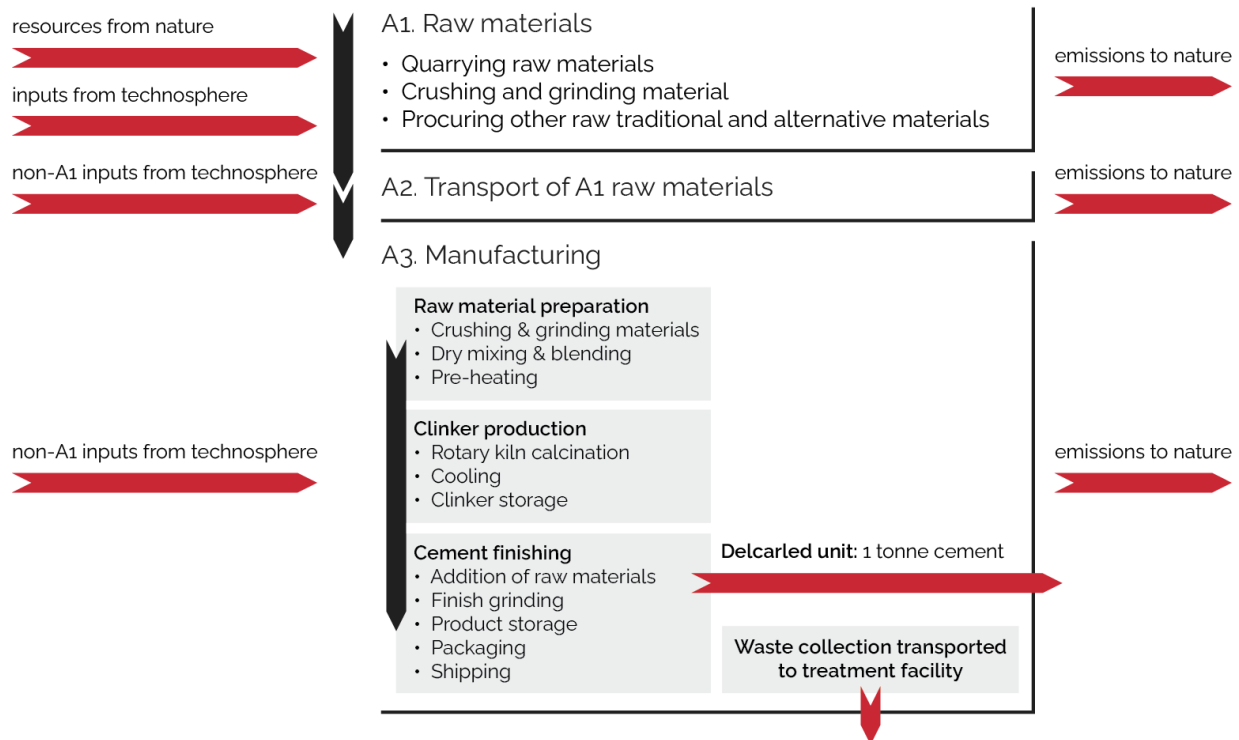


Figure 3: General system inputs considered in the product system and categorized by modules in scope

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, earthmoving 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 Ecuador, is located at their Planta Latacunga facility in Ecuador. All operating data is formulated using the actual data from Holcim Ecuador'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 Ecuador 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 whereasecoinvent default multi-modal market mix distances were assumed for other inputs where no original data could be provided.

Electricity: Electricity consumption values are for Holcim Ecuador in calendar year 2021. A Power Purchase Agreement (PPA) is a long-term contract under which a business agrees to purchase electricity directly from a renewable energy generator. Power Purchase Agreements provide financial certainty to you and the project developer, which removes a significant roadblock to building new renewable facilities. Hidroabanico is an Ecuadorian private investment company that bases its management on Corporate Social Responsibility, which is the new way of managing companies to operate in an economic, social, and environmentally sustainable way, thus achieving sustainable development and value creation. The Abanico hydroelectric project is located in the southeastern region of Ecuador, 15 kilometers from the city of Macas (Morona canton), the capital of the province of Morona Santiago, in an area far from population centers. Hidroabanico is a run-of-the-river hydroelectric plant without a reservoir, which controls the excess flow through the spillway and bottom drains.

Process/space heating: Not applicable.

Fuel required for machinery: Machinery-related fuel requirements were determined from direct Holcim information for propane use outside the kiln. Propane is used for moving vehicles for raw materials. Direct emission calculations for propane were calculated with ecoinvent 3.8 unit processes normalized to the amount of fuel used per ton of cement.

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

Recovered energy: Not Applicable.

Recycled/reused material/components: Not applicable.

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

Direct A3 emissions accounting: This plant is grinding and does not have a kiln; therefore, direct emissions are for moving vehicles only. All direct emissions data were calculated from Holcim



Ecuador's direct reporting of fuel usage and ecoinvent default processes for burning those fuels. Holcim Ecuador does not directly report its 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 hazardous waste disposal sites are near the plant therefore the 25 km distance is a representative estimate.

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 3: LCI inputs assumed for module A1 (i.e. raw material supply)

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Synthetic gypsum	limestone production, crushed, for mill/limestone, crushed, for mill/RoW/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	Pichincha	v3.8 in 2021	2	3	1	3	3
Clinker	Clinker for export-Planta.Guayaquil-Holcim.Ecuador	Program Operator: Labeling Sustainability- EPD ID: e717da92-6eee-4fdb-b7d3-acfac1d3df01	Guayaquil	29 November 2022	2	3	3	3	3
Natural gypsum	gypsum quarry operation/gypsum, mineral/RoW/kg	ecoinvent v3.8	Guayaquil	v3.8 in 2021	2	3	1	3	3
Pozzolana	calcareous marl production/calcareous marl/RoW/kg	ecoinvent v3.8	Cotopaxi	v3.8 in 2021	2	3	1	3	3

DATA QUALITY ASSESSMENT

Data quality/variability requirements, as specified in the PCR, are applied. This section describes the achieved data quality relative to the ISO 14044:2006 requirements. Data quality is judged based on its



precision (measured, calculated, or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied within a study serving as a data source) and representativeness (geographical, temporal, and technological).

Precision: Through measurement and calculation, the manufacturers collected and provided primary data on their annual production. For accuracy, the LCA practitioner and 3rd Party Verifier validated the plant gate-to-gate data.

Completeness: All relevant specific processes, including inputs (raw materials, energy, and ancillary materials) and outputs (emissions and production volume) were considered and modeled to represent the specified and declared products. Most relevant background materials and processes were taken from ecoinvent v3.6 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 v3.6 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 Eco-Purpose's proprietary Cement 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.

Label Sustainability has developed a proprietary tool that allows the calculation of PCR-compliant LCA results for Cement 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 2020-01-01 to 2020-12-31.
- Upstream (background) LCI data was either the PCR specified default (if applicable) or more appropriate LCI datasets as found in the country-adjusted ecoinvent v3.6 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).

Table 4: Life cycle impact categories and life cycle inventory metrics

ID	LCIA.indicators	Abbreviations	Units
1	environmental impact: acidification	AP	moles of H ⁺ -Eq
2	environmental impact: eutrophication	EP	kg N
3	environmental impact: global warming	GWP	kg CO ₂ -Eq
4	environmental impact: ozone depletion	ODP	kg CFC-11-Eq
5	environmental impact: photochemical oxidation	PCOP	kg NO _x -Eq
6	material resources: metals/minerals: abiotic depletion potential (ADP): elements (ultimate reserves)	ADPe	kg Sb-Eq
7	energy resources: non-renewable: abiotic depletion potential (ADP): fossil fuels	ADPf	MJ, net calorific value
Inventory metrics			
8	Total primary energy	TPE	MJ-Eq
9	Renewable energy	RE	MJ-Eq
10	Non-renewable energy	NRE	MJ-Eq
11	Non-Renewable Resources	NRR	kg
12	Renewable Resources	RR	m ³
13	water depletion: WDP	WDP	m ³
14	land filling: bulk waste	LFW	kg waste
15	land filling: hazardous waste	LFHW	kg waste
16	resource: carbon, biogenic, fixed	bioC	kg

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 1 tonne of cement basis.

Table 5: Total life cycle (across modules in scope) impact results for All declared products, assuming the geometric mean point values on a per 1 tonne of cement basis

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	kg SO ₂ eq	kg N	kg CO ₂ -Eq	kg CFC-11	kg O ₃ eq	kg Sbeq	kg Sbeq
Maximum	113	0.118	823	2.81e-05	1.75	0.00212	3480
Mean	87.1	0.0916	627	2.18e-05	1.35	0.0017	2680
GU Cement	75.8	0.08	541	1.89e-05	1.17	0.00141	2320
HE Cement	113	0.118	823	2.81e-05	1.75	0.00173	3480
MH Cement	67.9	0.072	481	1.71e-05	1.05	0.00157	2080
HE/HS Cement	73	0.0772	520	1.83e-05	1.13	0.00167	2240
MS Cement	106	0.111	768	2.64e-05	1.63	0.00212	3260

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	bioC
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	kg	m ³ water-	kg waste	kg waste	kg
Maximum	4110	424	3670	138	0.0018 1	0.611	61.9	0.0035 4	0.0809
Mean	3190	357	2830	105	0.0014 2	0.504	49.4	0.0028 1	0.0544



GU Cement	2790	329	2450	90.7	0.0012 6	0.458	43.6	0.0024 8	0.043
HE Cement	4110	424	3670	138	0.0018 1	0.611	61.9	0.0035 4	0.0809
MH Cement	2510	307	2210	81.6	0.0011 4	0.425	40	0.0022 7	0.035
HE/HS Cement	2710	320	2380	87.3	0.00121	0.446	42.6	0.0024 2	0.04
MS Cement	3850	405	3440	129	0.0017	0.579	58.7	0.0033 5	0.0733

REFERENCES

ASTM Standards:

- 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

CSA Standards:

- CAN/CSA A3000 Cementitious Materials Compendium
- CAN/CSA G40.20/G40.21 General requirements for rolled or welded structural quality steel / Structural quality steel

ISO Standards:

- ISO 6707-1: 2014 Buildings and Civil Engineering Works - Vocabulary - Part 1: General Terms
- ISO 14021:1999 Environmental Labels and Declarations - Self-declared Environmental Claims (Type II Environmental Labeling)



- ISO 14025:2006 Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures
- ISO 14040:2006 Environmental Management - Life Cycle Assessment - Principles and Framework
- ISO 14044:2006 Environmental Management - Life Cycle Assessment - Requirements and Guidelines
- ISO 14067:2018 Greenhouse Gases - Carbon Footprint of Products - Requirements and Guidelines for Quantification
- ISO 14050:2009 Environmental Management - Vocabulary
- ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products

EN Standards:

- EN 16757 Sustainability of construction works - Environmental product declarations - Product Category Rules for concrete and concrete elements
- EN 15804 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

Other References:

- US EPA Waste Reduction Model (WARM), Fly Ash
Chapter: <http://epa.gov/climatechange/wycd/waste/downloads/fly-ash-chapter10-28-10.pdf>
- USGBC LEED v4 for Building Design and Construction, 11 Jan 2019 available at <https://www.usgbc.org/resources/pcr-committee-process-resources-part-b>
- USGBC PCR Committee Process & Resources: Part B, USGBC, 7 July 2017 available at <https://www.usgbc.org/resources/pcr-committee-process-resources-part-b>.

