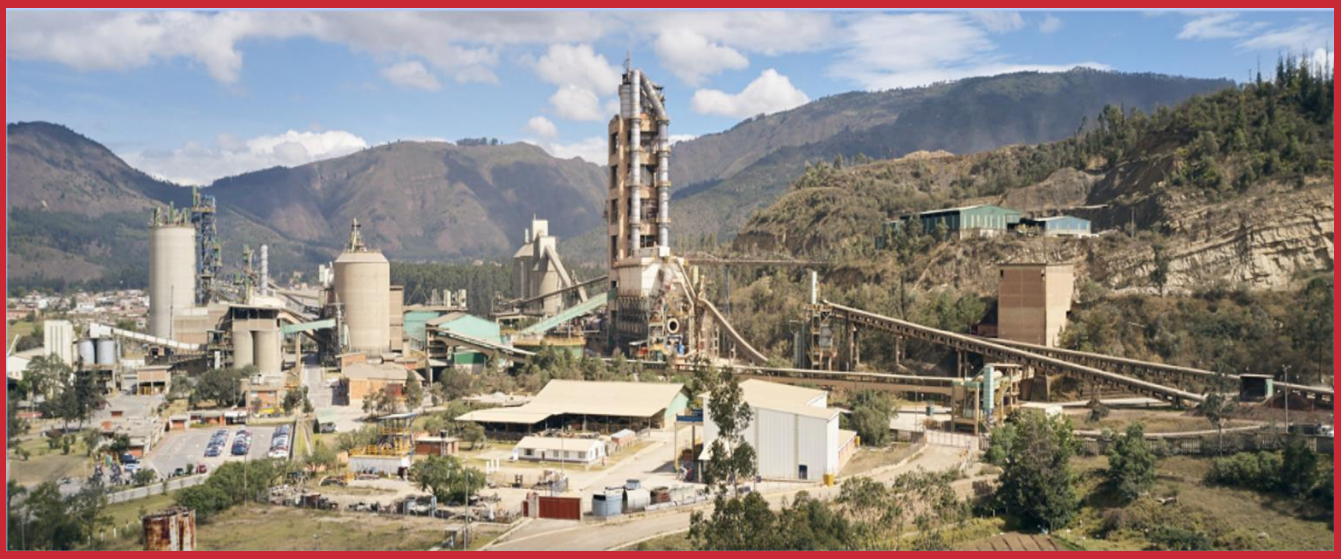
Environmental Product Declaration



Environmental Product Declaration for cement products produced by Holcim Colombia at their Nobsa facility in Boyacá. Colombia

TABLE OF CONTENTS

ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers cement products produced by Holcim Colombia Declared unit: 1 tonne of cement
Declaration Owner:	**Holcim Colombia** 7-45 Calle 13, Piso 12, Torre B, Ed. Teleport Business Park Bogotá, Colombia holcim.com.co
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 ☐ ; External ☐ X Third Party Verifier Geoffrey Guest, Certified 3rd Party Verifier under the CSA group (www.csaregistries.ca), Labeling Sustainability (www.labelingsustainability.com), P3Optima (www.P3Optima.com)
Date of Issue:	06 January 2023
Period of Validity:	5 years; valid until 06 January 2028
EPD Number:	6328e320-6can-4d85-83f4-dca33374d11b

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 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 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 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 2022, from January to October. The cement mix products for Holcim Colombia were completely revamped in June 2022. The mixes in this reported are the current mixes, produced at the Nobsa cement plant, made from primarily clinker and limestone. These six cement mixes make up 100% of yearly production at the Nobsa cement plant from June to October 2022. In order to conduct this study all cement products were modeled but the products no longer in production were omitted from this report. Cement from the Nobsa cement plant is used in the EPDs for concrete mixes in Colombia concrete plants.

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 @3 Days (MPa)	Resistance @28 Days (MPa)
1	CEMENTO PETROLERO G	Class G cement, High Sulfate Resistance, with compliance with ASTM C114 and API Spec10A 25 Ed.	Ordinary Portland	Proprietary	23	40
2	CEMENTO INDUSTRIAL ECOPLANET ART	Specially designed to produce more sustainable and highly durable concrete.	Ordinary Portland	Proprietary	23.4	43.2
3	CEMENTO INDS.FUERTE TIPO ART	Type ART cement, specially designed to produce highly durable concrete.	Ordinary Portland	Proprietary	29.4	46.5
4	CEMENTO FUERTE ECOPLANET UG	Cement designed for concrete, mortar and all kinds of construction works in general.	Ordinary Portland	Proprietary	13.2	27.3

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 presented breakdown has been randomly altered by +/-10% 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

A1 RAW MATERIAL RECYCLED CONTENT AND MATERIAL LOSSES

The following table provides a list of the raw material inputs (module A1) across all products considered, their recyclability content and assumed material losses.

Table 3: **Module A1 raw material inputs, the recyclability content and assumed material losses (dry basis)**

product.name	mix.category	primary.content	post.industrial. content	post.consumer. content	material. losses
bauxite	bauxite	1	0	0	0.02
Marble	natural stone plate, cut	1	0	0	0.02
Limestone	limestone, crushed, for mill	1	0	0	0.02
Fluorite	fluorspar, 97% purity	1	0	0	0.02
Coke	petroleum coke	1	0	0	0.02
Solid waste fuel	waste yarn and waste textile	0	0	1	0.02
Natural gas	natural gas, high pressure	1	0	0	0.02
Clinker batch Type 1	clinker	1	0	0	0
Limestone	limestone, crushed, for mill	1	0	0	0.02
Gypsum	gypsum, mineral	1	0	0	0.02
pozzolana	lignite ash	1	0	0	0.02
Slag	cement, blast furnace slag 66-80%	0	0	1	0.02

SYSTEM BOUNDARIES

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

Life Cycle Impacts

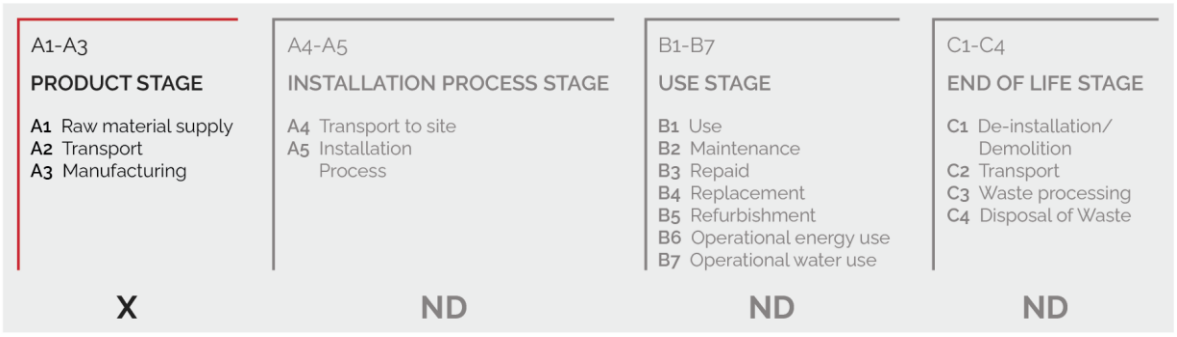


Figure 1: **General life cycle phases for consideration in a construction works system**

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.

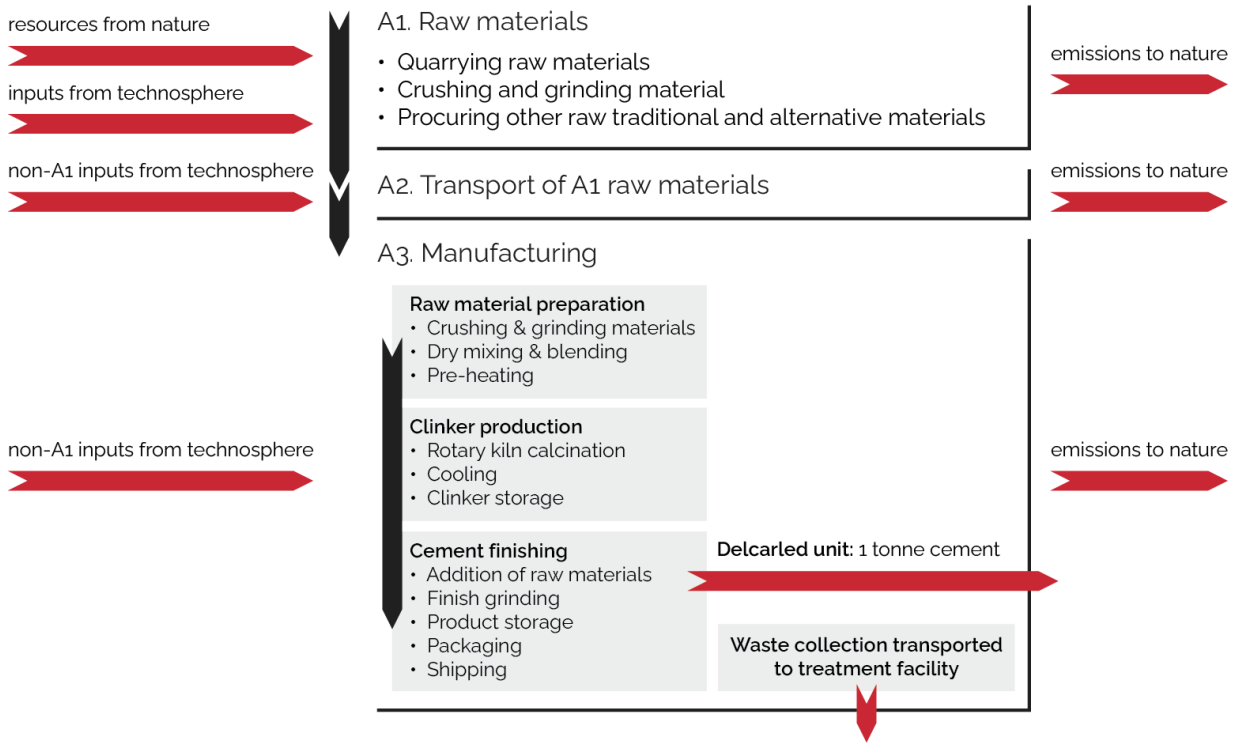


Figure 2: **General system inputs considered in the product system and categorized by modules in scope**

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, 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 Colombia, is located at their Planta Nobsa facility in Colombia. All operating data is formulated using the actual data from Holcim Colombias'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: Holcim Colombia provided primary data for the amount of electricity used in 2022, The unit process "market for electricity, medium voltage/electricity, medium voltage/CO/kWh" was used to represent the amount of electricity used from the national grid of Colombia

Process/space heating: No fuel is used for space heating at this facility in 2022

Fuel required for machinery: Machinery-related fuel requirements were determined from direct Holcim Colombia calculations for 2022.

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 (2%) loss factors were assumed.

Direct A3 emissions accounting: Direct emissions were calculated using adjusted default values. The carbon released during clinker calcination was calculated using the equation in the IPCC guidelines. The default value for the fraction of lime in clinker is 64.4% multiplied by the molecular weight ratio of CO_2 and CaO, 0.785. The total is 0.507 tons of CO_2/ton of clinker. The emissions from the combustion of the materials in the kiln are calculated for both fossil and non-fossil CO_2 emissions from the fuels used. The resulting non-CO_2 emissions are from the ecoinvent unit process for clinker.

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

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Marble (to make Clinker batch Type 1)	natural stone plate production, cut/natural stone plate, cut/RoW/kg	ecoinvent v3.8	Boyaca	v3.8 in 2021	2	3	2	3	3
Natural gas (to make Clinker batch Type 1)	market for natural gas, high pressure/natural gas, high pressure/RoW/m3	ecoinvent v3.8	Boyaca	v3.8 in 2021	2	3	1	3	3
Fluorite (to make Clinker batch Type 1)	fluorspar production, 97% purity/fluorspar, 97% purity/GLO/kg	ecoinvent v3.8	Cundinamarca	v3.8 in 2021	2	3	1	3	3
Coke (to make Clinker batch Type 1)	petroleum coke production, petroleum refinery operation/petroleum coke/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	1	3	3
pozzolana	treatment of lignite ash, sanitary landfill/lignite ash/RoW/kg	ecoinvent v3.8	Boyacá	v3.8 in 2021	2	3	2	3	3
bauxite (to make Clinker batch Type 1)	bauxite mine operation/bauxite/GLO/kg	ecoinvent v3.8	Valle del Cauca	v3.8 in 2021	2	3	2	3	3
Limestone (to make Clinker batch Type 1)	limestone production, crushed, for mill/limestone, crushed, for mill/RoW/kg	ecoinvent v3.8	Boyaca	v3.8 in 2021	2	3	2	3	3
Gypsum	gypsum quarry operation/gypsum, mineral/RoW/kg	ecoinvent v3.8	Santander	v3.8 in 2021	2	3	2	3	3
Solid waste fuel (to make Clinker batch Type 1)	Waste input produced off-site	See A3 inputs	cundinamarca	See A3 inputs	2	A3	2	A3	A3

DATA QUALITY ASSESSMENT

Data quality/variability requirements, as specified in the PCR, are applied. This section describes the achieved data quality relative to the ISO 14044:2006 requirements. Data quality is judged based on its precision (measured, calculated, or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied within a study serving as a data source) and representativeness (geographical, temporal, and technological).

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

Completeness: All relevant specific processes, including inputs (raw materials, energy, and ancillary materials) and outputs (emissions and production volume) were considered and modeled to represent the specified and declared products. 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 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 v3.6 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).

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 9: **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	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	56.6	0.0882	479	3.52e-05	0.903	0.000175	2300
Maximum	113	0.175	978	7.02e-05	1.8	0.00314	4580
Mean	83.1	0.129	714	5.18e-05	1.32	0.00223	3380
Median	87.6	0.136	752	5.48e-05	1.4	0.00256	3580
Cemento Petrolero G	107	0.165	930	6.6e-05	1.7	0.0018	4300
Cemento Industrial Ecoplanet Art	71.8	0.112	617	4.51e-05	1.14	0.00288	2940
Cemento Inds.Fuerte Tipo Art	89.3	0.139	767	5.59e-05	1.42	0.00291	3650
Cemento Fuerte Ecoplanet UG	56.6	0.0882	479	3.52e-05	0.903	0.0018	2300

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste
Minimum	2800	341	2470	94.3	0.000261	0.229	22.5	0.0014
Maximum	5280	349	4910	190	0.00044	0.359	37.7	0.00244
Mean	3980	345	3630	137	0.000356	0.286	30.2	0.00194
Median	4160	346	3820	146	0.000376	0.294	30.2	0.00206
Cemento Petrolero G	5010	347	4580	147	4e-04	0.335	26.8	0.00216
Cemento Industrial Ecoplanet Art	3520	343	3170	121	0.000319	0.232	28.1	0.00174
Cemento Inds.Fuerte Tipo Art	4240	346	3920	150	0.000389	0.297	33.9	0.00213
Cemento Fuerte Ecoplanet UG	2800	341	2470	94.3	0.000261	0.241	22.5	0.0014

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.