FUTURO EN ACCIÓN

CEMEX

DECLARACIÓN AMBIENTAL DE PRODUCTO

CEMENTO
Planta Santa Rosa **/ Colombia**

SOSTENIBILIDAD COLOMBIA
2024

Declared product:

This Environmental Product Declaration (EPD) covers cement products manufactured by CEMEX Colombia in the Santa Rosa Plant.

Declared unit**:** 1 tonne of cement

Declaration Owner:

CEMEX Colombia S.A.
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ISO 21930:2017 Sustainability in Building Construction – Environmental Declaration of Building Products serves as the core PCR.

NSF PCR for PCR for Portland, Blended, Masonry, Mortar, and Plastic (Stucco) Cements v3.2 serves as the subcategory PCR

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✓ External ☐ Internal

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EPD Software Tool: GCCA Industry EPD Tool for Cement and Concrete (V4.2), North American version.

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Period of validity: 10 January 2030
EPD Number: CCO01102502

ENVIRONMENTAL PRODUCT DECLARATION

CEMEX COLOMBIA
Santa Rosa Cement Plant

1. COMPANY DESCRIPTION

CEMEX S.A.B. de C.V. (CEMEX) is a global building materials company dedicated to building a better future through sustainable products and solutions. CEMEX is committed to achieving carbon neutrality through constant innovation and industry leadership in research and development. CEMEX is at the front of the circular economy within the construction value chain and promotes innovative processes with the use of advanced technologies to increase the use of waste as raw materials and alternative fuels in its operations. CEMEX provides cement, ready-mix concrete, aggregates, and urban solutions in fast-growing markets around the world, powered by a multinational workforce focused on delivering superior customer experience, using digital technologies.

Cemex Colombia's cement plants have an environmental management system certified under ISO 14001, which guarantees that the environmental impact is being rigorously measured, that pollution is being prevented and that continuous improvement is enabled.

2. 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 Portland, Blended, Masonry, Mortar, and Plastic (Stucco) Cements (version 3.2, dated September 2021) 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. EPDs for cements that follow other PCRs may not be comparable.

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 CEMEX S.A.B. de C.V.

from their competition for the following reasons: generate an advantage for the organization; offer customers information to help them make informed product decisions; improve the environmental performance of CEMEX S.A.B. de C.V. by continuously measuring, controlling and reducing the environmental impacts of their products; help project facilitators working on Leadership in Energy and Environmental Design (LEED) projects achieve their credit goal; and to strengthen CEMEX S.A.B. de C.V. license to operate in the community. The intended audience for this LCA report is CEMEX S.A.B. de C.V. 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.

Only EPDs prepared from cradle-to-grave life-cycle results and based on the same function, reference service life, and quantified by the same functional unit, can be used to assist purchasers and users in making informed comparisons between products. Since EPDs developed under these PCR only cover the cradle-to-gate impacts of Portland, blended hydraulic, masonry, mortar, or plastic (stucco) cements, using a declared unit, the results cannot be used to compare products used in different mixtures and construction products. The results from Portland, blended hydraulic, masonry, mortar, or plastic (stucco) cements EPD must be integrated into a comprehensive cradle-to-grave, ISO 14044-compliant LCA to compare between different products. The basis of a comparison, where applicable, shall include the product application in accordance with ISO 21930 ASTM (2014).

3. PRODUCT INFORMATION

- **Product Identification**

This EPD is prepared for products classified as UN CPC Group 3744-Cement or CSI MasterFormat Division 03 30 00 Cast-in-Place Concrete.

- **Cement Design Summary**

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

Table 1. Declared products considered in this Environmental Product Declaration

N°	ID	Description	Strength at 3 days (MPa)	Strength at 28 days (MPa)
1	Cemento ART	High Early Strength Cement	> 15.0	> 39.0
2	Cemento Super Resistente	General Use Type Cement	14.0 - 21.0	24.0 - 28.0
3	Cementante Vertua	Low Carbon Cementitious Material	-	-

The following table provides the mass breakdown (kg per functional unit) of the material composition of each cement design considered. No regulated substances of very high concern are utilized on site.

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	20 – 90
Others	0.003 – 1.75
Total	100.00

4. Life Cycle Assessment (LCA)

4.1 Declared Unit

This Environmental Product Declaration refers to **1 ton of cement**

4.2 Time representativeness

All data was collected by CEMEX at its own plants between January and December 2023 (12 months) and the data collected is representative of the production technology used in 2023.

4.3 LCA Software and Data Bases Used

The Life Cycle Assessment was developed using the GCCA Industry EPD Tool for Cement and Concrete (V4.2), North American version, which uses Ecoinvent v3.5 and GCCA datasets for the LCA database.

4.4 System Boundaries

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

Environmental assessment information
(MA – Module assessed, MNA – Module not assessed, INA – Indicator Not Assessed)

Product stage			Construction process		Use stage							End of life				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufaturing	Transport to construction site	Construction installation process	Use	Maintenance	Repair	Refurbishment	Operational energy use	Operational water use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse-recovery recycling potential
A1	A2	A3	A4	A5	B1	B2	A3	B4	B5	B6	B7	C1	C2	C3	C4	D
MA	MA	MA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	|

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

1. A1: Raw material supply (upstream processes) - Extraction, handling, and processing of the materials used in manufacturing the declared products in this LCA.
2. A2: Transportation - Transportation of A1 materials from the supplier to the "gate" of the manufacturing facility (i.e., A3). The Life Cycle Assessment model for the North American version of the GCCA EPD Tool considers common practices in the cement and concrete industry.
3. A3: Manufacturing (core processes)- The energy and other utility inputs used to store, move, and manufacture the declared products and to operate the facility.

The subcategory PCR recognizes fly ash, silica fume, granulated blast furnace slag, cement kiln dust, flue gas desulfurization (FGD) gypsum, and post-consumer gypsum as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a cement material input.

Not all LCA datasets for upstream materials include these impact categories and thus results may be incomplete. Use caution when interpreting data in these categories.

In addition, according to the relevant PCR, the following requirements are excluded from this study:

- Production, manufacture and construction of A3 concrete/building/capital goods and infrastructure.
- Production and manufacture of production equipment, delivery vehicles, earthmoving equipment, and laboratory equipment.
- Personnel-related activities (travel, furniture, office supplies). • Energy use related to company management and sales activities.

4.5 Process Information

4.5.1 Modules A1 - A2: Extraction and transport of raw materials

Limestone and clay are extracted from the stone quarries by drilling and blasting with explosives, the impact of which is minimal thanks to the modern technology used. Once the large masses of stone have been fragmented, they are transported to the plant in trucks or conveyor belts.

The entire extraction process has rigorous operational controls that mitigate environmental impact, allow comprehensive monitoring and ensure compliance with the requirements of current environmental regulations.

The quarry material is fragmented in crushers and, by impact and/or pressure, reduced to a maximum size of one and a half inches. Then, in the pre-homogenization process, the proportional mixing of the different types of clay, limestone or any other material that requires is carried out. Each of the raw materials is transported separately to silos where they are dosed to produce different types of cement.

They are then ground using a vertical steel mill, which grinds the material by means of the pressure exerted by three conical rollers rolling on a rotating grinding table. Horizontal mills are also used for this phase, in which the material is pulverized by means of steel balls.

The homogenization process of raw meal is carried out in silos equipped to achieve a homogeneous mixture of the material. This meal is then subjected to a calcination process, the core part of the process, where large rotary kilns are used, inside which, at 1400°C, the flour is transformed into clinker, which are small dark grey modules of 3 to 4 cm.

The clinker is then transported from Caracolito Cement Plant to Santa Rosa Plant for grinding/milling, cement production and packing. Santa Rosa has

Truck transportation calculations are based on the weight of transported products per unit of clinker or cement and on the distances travelled per transported product. The volume of the materials was not considered because the majority of the transported materials are weight-limited and not volume-limited. In the Ecoinvent datasets, the allocation of a truck's impact to the merchandise transported is done through a top-down approach, considering the total tonnes and total km transported. An average load factor is considered (5.79 t for 16-32 t trucks i.e. 39% average load rate and 15.96 t for > 32 t trucks, i.e. 71% average load factor) – this average load factor accounts for all truck journeys including empty backhauls and is used to allocate an impact per truck per km to a tonne transported over 1 km (one tkm). In effect, this approach allocates empty backhauls, on average, to a tkm of transported merchandise. Infrastructure, maintenance and end-of-life of roads and trucks are taken into consideration, assuming a 540'000 km lifetime per truck.[1]

[1] Information taken from the GCCA Industry EPD Tool for Cement and Concrete: LCA Model, North American version, 18 December 2023.

4.5.2 Module A3: Production

The clinker is ground through steel balls of different sizes as it passes through the two chambers of the mill, adding gypsum to lengthen the setting time of the cement. The cement is sent to the storage silos; from which it is extracted by pneumatic or mechanical systems, being transported to where it will be packaged in paper sacks or supplied directly in bulk.

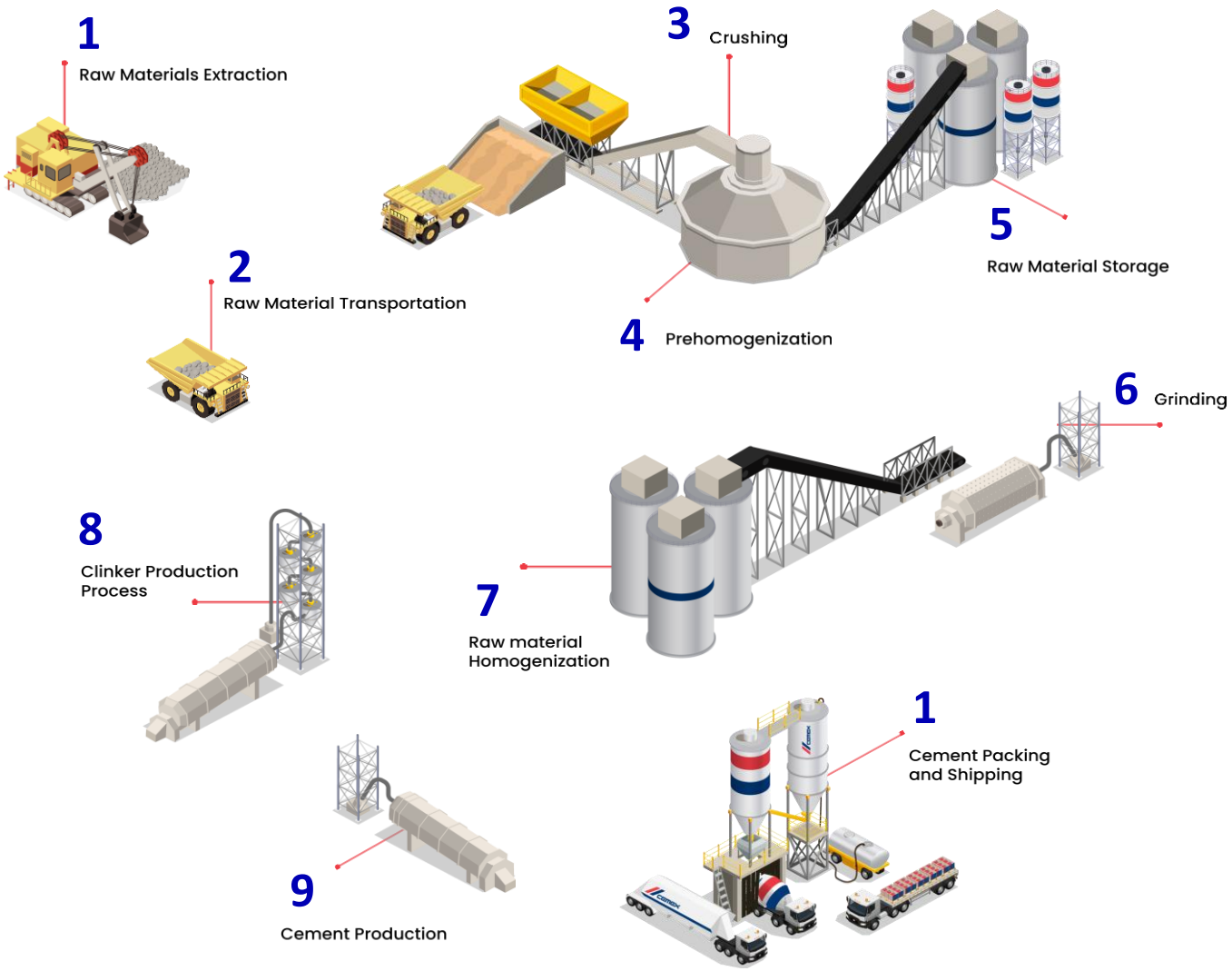

Figure 2. Cement Production

5. 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%.

6. DATA SOURCES

- Raw material transport: Actual distance data is provided for each key bulk material. For those materials with more than one supplier, the distance is weighted to obtain a single datum.
- Electricity: CEMEX Colombia, Santa Rosa Plant, consumes electricity from various electricity sources and suppliers, including the national grid and self-generation sources such as Sueva hydroelectric plant. To calculate the site-specific electricity mix used in the EPD Tool, aligning with the PCR, the site-specific electricity mix is distributed proportionally to the plant's energy consumption (electricity purchased from the grid + self-generation from Sueva plant).

  The national electricity mix used is published by the authorities (UPME, Colombia's Mining and Energy Planning Unit)
- Fuel required for machinery: Fuel needs related to machinery were determined from direct calculations by CEMEX using GCCA methodology with actual accounting of consumption at the plant.
- Waste generation: Waste generation values are directly reported from CEMEX operations.
- Recovered energy: Thermal energy recovered from fuels produced from recycled materials. It was 31.0% average for cement plants Colombia in 2023.
- Recycled/reused material/components: Santa Rosa cements use a significant amount of recycled material in the blend. CEMEX is committed to sustainability and circularity practices. Cemex uses post-industrial material waste as inputs to its products, to save virgin raw materials as well as reducing impacts within and outside its boundaries. Some common recycled raw materials include recovered brick from Construction and Demolition Waste, fly-ash, ground granulated blast-furnace slag and waste calcined clay. The quantities are directly reported from CEMEX operations.
- Direct A1 and A3 emissions accounting: The direct CO2 emissions of the plant (calcination process and fuel) were calculated following the methodology stipulated in "The Cement CO2 and Energy Protocol[2]" of the GCCA. Process emissions were estimated using method A2 - Analysis of the CO2 released from total carbon (TC) of raw meal. Emissions are mainly from fuels burned on-site (kiln and non-kiln fuels) and calculated in the clinker phase in the Caracolito plant. These emissions were estimated using fossil fuel Emission Factors from the IPCC Energy Module - 2006, as well as Emission Factors for alternative fuels suggested by the GCCA. These direct emissions are audited by a third party annually. All other emissions were obtained from Ecoinvent Emission Factor data and the respective consumptions recorded by the plant.

[2] https://www.cement-co2-protocol.org/en/

- Waste transport requirements**:** Transport distances use actual values between the plant location and the waste treatment location.

7. DATA QUALITY ASSESSMENT

Data quality/variability requirements, as specified in the PCR, are applied. This section describes the data quality achieved 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: Thorough measurement and calculation; the manufacturer collected and provided primary data on their annual production.

- 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 v3.5 LCI datasets and GCCA data 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 GCCA EPD Tool (which includes the Ecoinvent v3.5 database and GCCA data) were used across all product systems. Cross checks 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 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.

- Life Cycle Assessment tool: The Global Cement and Concrete Association (GCCA) is a CEO-led industry initiative. Its members, Board of Directors, and Executive team are committed to sustainability – reducing the impacts of cement production and promoting the unique properties of concrete as a sustainable, durable and resilient building material – a material that will answer the needs of a growing and increasingly urban population that is set to exceed 9 billion people by 2050.

GCCA's Industry EPD Tool for Cement and Concrete is a web-based calculation tool for EPDs of clinker, cement, aggregates, concrete and precast elements, available in both International and North American versions. The latter complies with the latest North American cement and concrete PCRs registered at NSF International, namely PCR for Portland, Blended, Masonry, Mortar, and Plastic (Stucco) Cements (version 3.2, dated September 2021), the PCR for Concrete (version 3.2, dated February 2022) and the PCR for Precast Concrete (version 3.0, dated May 2021), all registered at NSF International.

The tool produces a background report with the complete set of input data and results of the specific product. This document is in the form of an Excel file that contains all the information required to produce an EPD and for a verifier to validate it.

- Representativeness: The representativeness of the data is summarized as follows.
    - Time related coverage of the manufacturing processes' primary collected data from 2023-01-01 to 2023-12-31.
    - Upstream (background) LCI data was either the PCR specified default (if applicable) or more appropriate LCI datasets as found in the country-adjusted Ecoinvent v3.5 database.
    - Geographical coverage for inputs required by the A3 facility is representative of its region of focus; other upstream and background processes are based on US, North American, regional 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.

8. 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.

9. 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.

10. ENVIRONMENTAL IMPACT SUMMARY

Table 3. Core environmental impact indicators

Environmental Impacts: 1 tonne of cement.								
Indicator	**GWP-tot ***	**GWP-bio ***	**ODP**	**AP**	**EP**	**POCP**	**ADPE**	**ADPF**
Unit	**kg CO_2 eq.**	**kg CO_2 eq.**	**kg CFC 11 eq.**	**kg SO_2 eq.**	**kg N eq**	**kg O_3 eq.**	**kg Sb eq.**	**MJ, net calorific value**
Cemento ART	782	1.30E-1	1.63E-5	3E0	7.57E-1	5.91E1	1.2E-4	2.82E3
Cemento Super Resistente	436	9.82E-2	1.07E-5	1.69E0	4.34E-1	3.33E1	9.09E-5	1.65E3
Cementante Vertua	158	4.24E-2	6.10E-6	6.32E-1	1.76E-1	1.22E1	9.38E-5	6.87E2
Acronyms	GWP-tot (Global warming potential) • GWP-bio (Global warming potential, biogenic) • ODP (Depletion potential of the stratospheric ozone layer) • AP (Acidification potential of soil and water sources) • EP (Eutrophication potential) • POCP (Photochemical oxidant creation potential) • ADPE (Abiotic depletion potential for non-fossil mineral resources) • ADPF (Abiotic depletion potential for fossil resources)							

Table 4. Parameters describing resource use

Resources Used: 1 tonne of Cement.										
Indicator	**PERE**	**PERM**	**PERT**	**PENRE**	**PENRM**	**PENRT**	**SM**	**RSF**	**NRSF**	**NFW**
Unit	**MJ**	**MJ**	**MJ**	**MJ**	**MJ.**	**MJ**	**kg**	**MJ**	**MJ**	**m^3**
Cemento ART	1.43E2	0.00E+00	1.43E2	2.84E3	0.00E+00	2.84E3	8.63E1	8.73E1	1.06E3	7.89E-1
Cemento Super Resistente	8.60E1	0.00E+00	8.60E1	1.65E3	0.00E+00	1.65E3	3.05E2	4.8E1	5.83E2	5.09E-1
Cementante Vertua	3.99E1	0.00E+00	3.99E1	6.87E2	0.00E+00	6.87E2	4.85E2	1.64E1	1.99E2	2.87E-1
Acronyms	PERE (Use of renewable primary energy excluding renewable primary energy resources used as raw materials) • PERM (Use of renewable primary energy resources used as raw materials) • PERT (Total use of renewable primary energy resources) • PENRE (Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials) • PENRM (Use of non-renewable primary energy resources used as raw materials) • PENRT (Total use of non-renewable primary energy resources) • SM (Use of secondary materials) • RSF (Use of renewable secondary fuels) • NRSF (Use of non-renewable secondary fuels) • NFW (Net use of fresh water)									

Table 3. Core environmental impact indicators

Other Environmental Information: 1 tonne of cement		
Indicator	**Net GWP-tot ***	**Net GWP-bio ***
Unit	**kg CO_2 eq.**	**kg CO_2 eq.**
Cemento ART	679	8.79E-2
Cemento Super Resistente	379	7.51E-2
Cementante Vertua	138	3.45E-2
Note: The indicated values (gross values) include the greenhouse gas emissions from the incineration of secondary fuels at clinker production. The net GWP values exclude the emissions from the incineration of secondary fuels at clinker production.		

11. REFERENCES

- 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 21930, Sustainability in building construction — Environmental declaration of building products.
- Labeling Sustainability - Program Operator for Product Category Rules (PCRs) and Environmental Product Declarations (EPDs): General Program Instructions
- NTC 220 - Cementos. Determinación de la resistencia de morteros de cemento hidráulico a la compresión, usando cubos de 50 mm o 2 pulgadas de lado.
- NSF International PCR for Portland, Blended, Masonry, Mortar, and Plastic (Stucco) Cements v3.2
- GCCA Industry EPD Tool for Cement and Concrete (v4.1), North American Version