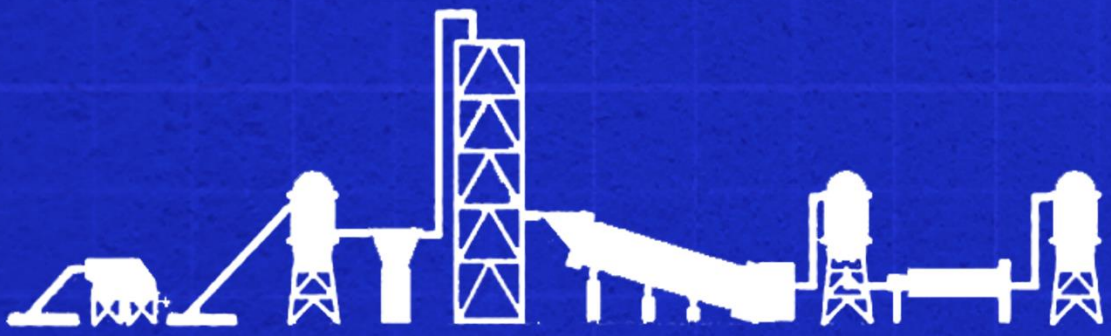
CEMEX

ENVIRONMENTAL PRODUCT DECLARATION



Environmental Product Declaration for cement products produced by CEMEX S.A.B. de C.V. at their Hermosillo (CPN) facility in Sonora, México

FUTURO EN ACCIÓN

ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers cement products produced by CEMEX S.A.B de C.V . Declared unit: 1 tonne of cement.
Declaration Owner:	CEMEX S.A.B de C.V
	444 Av. Constitución, Col. Centro
	Monterrey, Nuevo León
	www.cemexmexico.com
Program Operator:	Labeling Sustainability
	Address, 11670 W Sunset Blvd.
	City, State, Los Angeles, CA
	http://labelingsustainability.com/
Product Category Rule:	Core PCR: ISO 21930:2017 Sustainability in building and civil engineering works- Core rules for environmental product declarations of construction products and services SubPCR: (Used as a guidance document only) NSF International (March 2020). 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. 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 .
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 CSA group (www.csaregistries.ca), Labeling Sustainability (www.labelingsustainability.com), P3Optima (www.P3Optima.com)
Date of Issue:	28 March 2023
Period of Validity:	5 years; valid until 28 March 2028
EPD Number:	30af63b7-21b3-4892-8cda-fa4df53f61d5

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COMPANY DESCRIPTION

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 and reduced carbon footprint 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 a superior customer experience, using digital technologies.

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 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 a 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).

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.

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 discarded gypsum molds used to produce ceramic and metallic pieces; aggregate residues from screening, not usable by construction or concrete manufacturers due to particle size and contamination with clays prone to moulder; the by-product waste from mineral concentration by flotation; and ceramics from bathroom furniture which did not meet the manufacturer's quality standards. Other types of industrial and urban wastes are recycled as fuels inside huge clinker kilns, with energy contributions containing typically up to 30% biogenic carbon from natural non-fossil sources. The combination of both these efforts produces, first cement and later concrete, recycling and integrating materials into their production, preserving natural resources, and mitigating environmental impacts as well as climate change.

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 considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	Resistance @3 Days (MPa)	Resistance @28 Days (MPa)
1	CPC40	Portland Composite Cement class 40.	Portland Cement	N/A	40
2	CPC40RS	Portland Composite Cement class 40 with Sulfate Resistance.	Portland Cement	N/A	40
3	CPO40 Exp	Portland Ordinary Cement class 40	Portland Cement	N/A	40
4	Cement Type IP	Portland Pozzolan Cement	Blended Cement	N/A	40

CEMENT DESIGN COMPOSITION

The following table 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:

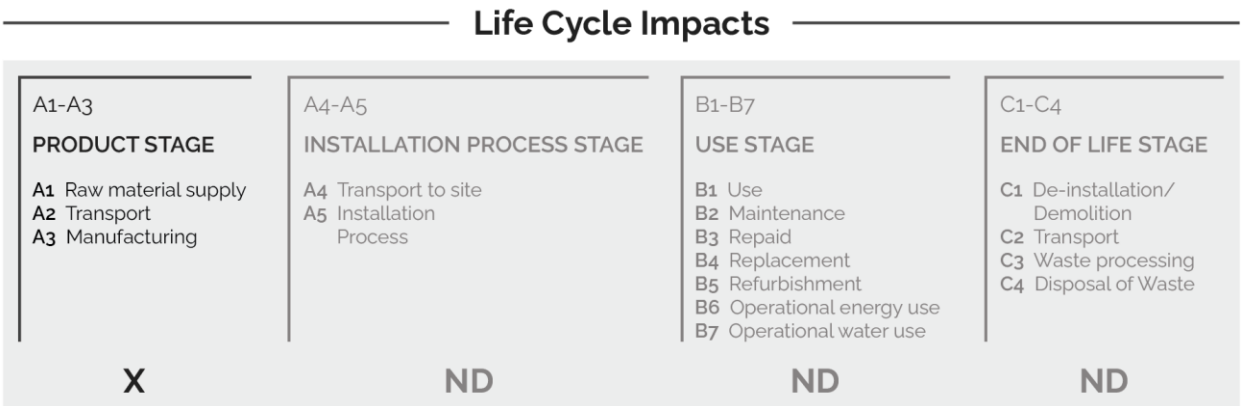

Figure 1: **General life cycle phases for consideration in a construction works system**

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.

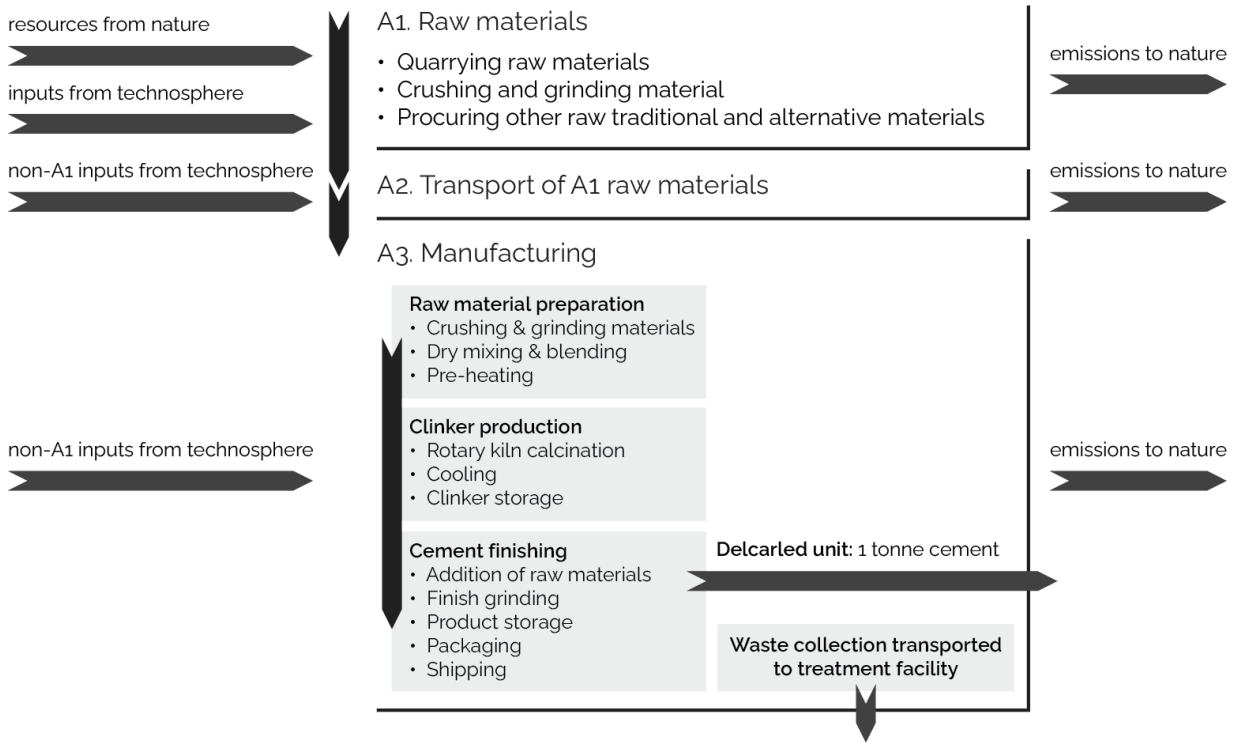

Figure 2: **General system inputs considered in the product system and categorized by modules in scope**

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

- Production, manufacture and construction of A3 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.

For this LCA the manufacturing plant, owned and operated by CEMEX S.A.B. de C.V., is located at their Planta Hermosillo facility in Mexico. All operating data is formulated using the actual data from CEMEX S.A.B. de C.V. plant at the above location, including 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 CEMEX S.A.B. de C.V. 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: CEMEX Mexico, Planta Hermosillo, purchases electricity from multiple electricity providers. All electricity usage uses the unit process for the CFE national grid to better align with the PCR. All information on plant usage is primarily reported CEMEX information. The process "electricity market, medium voltage/electricity, medium voltage/MX/kWh" was used to represent electricity used at the plant.

Process/space heating: No fuel was consumed for process/space heating; all fuel used at this factory was accounted for using primary reported data (reference year 2021) and Ecoinvent 3.8 unit processes.

Fuel required for machinery: Machinery-related fuel requirements were determined from direct CEMEX calculations using the GCCA methodology. Natural gas is reported by CEMEX yearly and these values are the same reported for 2021. CEMEX does not own the equipment and does not report that as part of their requirement to the Mexican government.

Waste generation: Waste generation values are directly reported from CEMEX operations.

Recovered energy: Thermal energy recovered from fuels produced from recycled materials. Is 25.84% average in Mexico's cement plants. .

Recycled/reused material/components: Previously discussed in the section "Description of Product and Scope".

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

Direct A3 emissions accounting: This EPD uses direct plant emissions for fuels burned on-site. Consumption values and subsequent emissions were reported based on the plant's self-reported energy matrix in their annual report, "REGISTRO DE EMISIONES Y TRANSFERENCIA DE CONTAMINANTES (RETC) PARA ESTABLECIMIENTOS DE JURISDICCIÓN FEDERAL DURANTE 2021" as required by Mexico law. Direct emissions at the plant are reported for CO_2, N_2O, and CH_4. All other emissions were derived from ecoinvent data for the relevant process associated with the emission activity. The fuels reported are both in the furnace and outside the furnace for vehicles and other

machinery. Such emissions are reported as "total" emissions, in contrast to the lesser "gross" emissions reported in the Kyoto Protocol, EU-ETS and other international reports.

Waste transport requirements: Transportation distances are using estimated values. The waste hauler cannot guarantee the exact distances travelled due to the variation of route and actual location of disposal. Most hazardous waste suppliers 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
Fluorite (to make Clinker batch Type 1)	fluorspar production, 97% purity/fluorspar, 97% purity/GLO/kg	ecoinvent v3.8	Multiple Origens	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 Origens	v3.8 in 2021	2	3	1	3	3
bauxite (to make Clinker batch Type 1)	bauxite mine operation/bauxite/GLO/kg	ecoinvent v3.8	Multiple Origens	v3.8 in 2021	2	3	1	3	3
Limestone (to make Clinker batch Type 1)	limestone production, crushed, for mill/limestone, crushed, for mill/RoW/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	Jalisco	v3.8 in 2021	2	3	2	3	3
Clay (to make Clinker batch Type 1)	clay pit operation/clay/RoW/kg	ecoinvent v3.8	Jalisco	v3.8 in 2021	2	3	2	3	3
Heavy Fuel Oil (to make Clinker	heavy fuel oil production, petroleum refinery	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	1	3	3

batch Type 1)	operation/heavy fuel oil/RoW/kg								
Gypsum (to make Clinker batch Type 1)	gypsum quarry operation/gypsum, mineral/RoW/kg	ecoinvent v3.8	Jalisco	v3.8 in 2021	2	3	2	3	3
Puzolana	calcareous marl production/calcareous marl/RoW/kg	ecoinvent v3.8	Jalisco	v3.8 in 2021	2	3	2	3	3
Iron ore (to make Clinker batch Type 1)	Waste input produced off-site	See A3 inputs	Puebla	See A3 inputs	1	A3	0	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 v3.8 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 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.

*Labeling 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 v3.8 database.
- Geographical coverage for inputs required by the A3 facility(ies) is representative of its region of focus; other upstream and background processes are based on US, North American, or global average data and adjusted to regional electricity mixes when relevant.
- Technological coverage is typical or average and specific to the participating facilities for all primary data.

ENVIRONMENTAL INDICATORS AND INVENTORY METRICS

Per the PCR, this EPD supports the life cycle impact assessment indicators and inventory metrics as listed in the tables below. As specified in the PCR, the most recent US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), impact categories were utilized as they provide a North American context for the mandatory category indicators to be included in the EPD. Additionally, the PCR requires a set of inventory metrics to be reported with the LCIA indicators (see tables below).

It should be noted that emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in any of the following categories.

LIMITATIONS

This EPD is a declaration of potential environmental impact and does not support or provide definitive comparisons of the environmental performance of specific products. Only EPDs prepared from cradle-to-grave life cycle results and based on the same function and reference service life and quantified by the same functional unit can be used to assist purchasers and users in making informed comparisons between products.

LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. Further, LCA offers a wide array of environmental impact indicators, and this EPD reports a collection of those, as specified by the PCR.

In addition to the impact results, this EPD provides several metrics related to resource consumption and waste generation. While these data may be informational in other ways, they do not provide a measure of impact on the environment.

TOTAL IMPACT SUMMARY

The following table reports the total LCA results for each product produced at the given cement facility on a per 1 tonne of cement basis.

Table 4: **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	108	0.149	817	6.22E-05	1.53	0.00133	4910
Maximum	131	0.184	1020	7.57E-05	1.93	0.00287	5720
Mean	122	0.170	947	7.01E-05	1.78	0.00228	5378
Median	125	0.174	975	7.13E-05	1.84	0.00246	5440
CPC40	123	0.170	960	6.92E-05	1.81	0.00133	5300
CPC40RS	127	0.178	989	7.34E-05	1.86	0.00248	5580
CPO40 Exp	131	0.184	1020	7.57E-05	1.93	0.00243	5720
Cement Type IP	108	0.149	817	6.22E-05	1.53	0.00287	4910

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	5290	133	5160	130	0.000600	0.429	20.7	0.00324
Maximum	6170	135	6100	151	0.000692	0.442	36.8	0.00389
Mean	5808	134	5695	142	0.000652	0.436	30.8	0.00366
Median	5885	134	5760	144	0.000657	0.437	32.8	0.00375
CPC40	5730	133	5610	140	0.000600	0.429	20.7	0.00324
CPC40RS	6040	134	5910	147	0.000682	0.44	32.9	0.00385
CPO40 Exp	6170	135	6100	151	0.000692	0.442	32.6	0.00389
Cement type IP	5290	133	5160	130	0.000632	0.434	36.8	0.00364

ADDITIONAL ENVIRONMENTAL INFO

Emissions

Table 5: **Direct Gross and Net CO2 emissions, consider GHG emission reductions, as defined by the Global Cement and Concrete Association (GCCA) guidelines.**

	Net kg CO2/t Cem.	Gross kg CO2/t Cem.
CPC40	788.8	795.6
CPC40RS	802.6	809.6
CPO40 Exp	836.4	843.7
Cement type IP	637.3	642.9

Renewable Energy

26.5% electricity from renewable sources (consolidated value for all CEMEX México cement plants)

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

REFERENCES

ASTM Standards:

- ASTM C150/C150M Standard Specification for Portland Cement
- ASTM C989/C989M Standard Specification for Slag Cement for Use in Concrete and Mortars
- ASTM C1157/C1157M Standard Performance Specification for Hydraulic Cement
- ASTM C1240 Standard Specification for Silica Fume Used in Cementitious Mixtures.
- ASTM C595 Standard Specification for Blended Hydraulic Cements.

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 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.