Environmental Product Declaration

Environmental Product Declaration for cement products produced by Holcim México Operaciones S.A. de C.V. at their Ramos Arizpe facility in Coahuila, México

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ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers cement products produced by Holcim México Operaciones S.A. de C.V. Declared unit: 1 tonne of cement
Declaration Owner:	Holcim México Operaciones S.A. de C.V. Av. Prol. Vasco de Quiroga #4800 Torre II Ofic. 101 Piso 1 Santa Fe, Cuajimalpa de Morelos, Ciudad de México, México holcim.com.mx
Program Operator:	Labeling Sustainability 11670 W Sunset Blvd. Los Angeles, CA 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:	05 July 2023, Updated 19 June 2024
Period of Validity:	5 years; valid until 05 July 2028
EPD Number:	624909e0-bd19-4de8-b2f1-4425cecdfada

COMPANY DESCRIPTION

Holcim Mexico produces and markets cement, ready-mix concrete, and other products and services for construction. The company has a nationwide presence through 7 cement plants with a current installed capacity to produce 12.6 million tons per year, 23 cement distribution centers, two maritime terminals, 1 Corporate Office, plus 35 ready-mix concrete plants, seven platforms, and a Geocycle transfer center, 26 commercial partners with more than 90 ready-mix concrete plants, more than 500 mixing pots, one aggregates plant and a Technological Innovation Center for Construction (CITEC).

Sustainable Development is an integral part of Holcim's strategy around the world. Holcim Mexico has a clear vision of the future it wants for our country, which contributes to its development. Holcim Mexico's main objective is to create value. Creating value ensures long-term business success in covering the triple bottom line (i.e., social, economic, environmental values). Finally, good operating performance and a solid return on invested capital go hand in hand with sustainable development.

Holcim continues to invest in research and development. They have the Innovation and Development Center, located in Lyon (France), with satellite locations in various regions developing a comprehensive portfolio of innovators and sustainable solutions. These include different categories: inclusive business models, water management solutions, urban mining solutions (recycled aggregates), waste treatment services, energy-efficient solutions (insulating building materials), resource-efficient solutions (high recycled content, bags soluble cement), and low CO_2 building materials.

Holcim operates with the belief that they can gain an advantage by developing knowledge and brand equity in the green building segment.

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 México Operaciones SA de CV 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 México Operaciones SA de CV 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 México

Operaciones SA de CV's license to operate in the community. The intended audience for this LCA report is Holcim México Operaciones SA de CV'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.

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 in order to compare between different products. The basis of a comparison, where applicable, shall include the product application in accordance with ISO 21930 ASTM (2014).

The PCR for cement, as listed as the subPCR used as a guidance document, includes a variety of ASTM specifications for cement. None of the ASTM standards listed in the PCR covers Rapid Set Cement. Rapid Set Cement falls under ASTM C1600; This is a performance-based specification for hydraulic cement in the same vein as ASTM C1157, included in the PCR. Representatives of CTS Cement appealed to the PCR committee, including the committee chair from NSF. CTS appeals were denied. The difference between the ASTM C1157 specification, which is included in the PCR, and the ASTM C1600 specification, under which Rapid Set Cement falls, is that ASTM C1600 includes rapid-hardening cement. C1157 excludes rapid hardening cement as it requires a minimum set time of 45 minutes.

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 2023. It reports on the four Portland cement mixes produced at the Ramos Arizpe cement plant, made from primarily limestone. These four cement mixes make up 100% of yearly production at the Ramos Arizpe cement plant. Cement from the Ramos Arizpe cement plant is used in the EPDs for concrete mixes for the following plants: Dulces Nombres, Escobedo, Mitras, Obispo, Pesqueria, Santa Catarina, Artega, Ramos Arizpe, and Derramadero which cover both the Monterrey and Saltillo regions of Mexico.

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	CPC30	Portland Composite Cement class 30.	Ordinary Portland	Proprietary	32.2
2	CPC40	Portland Composite Cement class 40.	Ordinary Portland	Proprietary	43.2
3	CPMM	Portland Cement used for non-structural masonry work.	Ordinary Portland	Proprietary	8.5
4	CPC40R	Portland Composite Cement class 40 with specified strength at 3 days.	Ordinary Portland	Proprietary	46.3

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 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

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**
Recovered material	Recovered Material	0	0	1	0.02
Waste concrete	limestone, unprocessed	0	0	1	0.02
FIRSU	polyethylene terephthalate, granulate, amorphous, recycled	0	1	0	0.02
Solid waste fuel	waste yarn and waste textile	0	0	1	0.02
Cardboard/paper	waste plaster-cardboard sandwich	0	1	0	0.02

Inert waste	inert waste	0	1	0	0.02
Wood waste	waste wood, untreated	0	1	0	0.02
Flyash	cement, pozzolana and fly ash 36-55%	0	0	1	0.02
Dust	limestone, unprocessed	1	0	1	0

SYSTEM BOUNDARIES

The following figure depicts the cradle-to-gate system boundary considered in this study (ND= Not Defined)

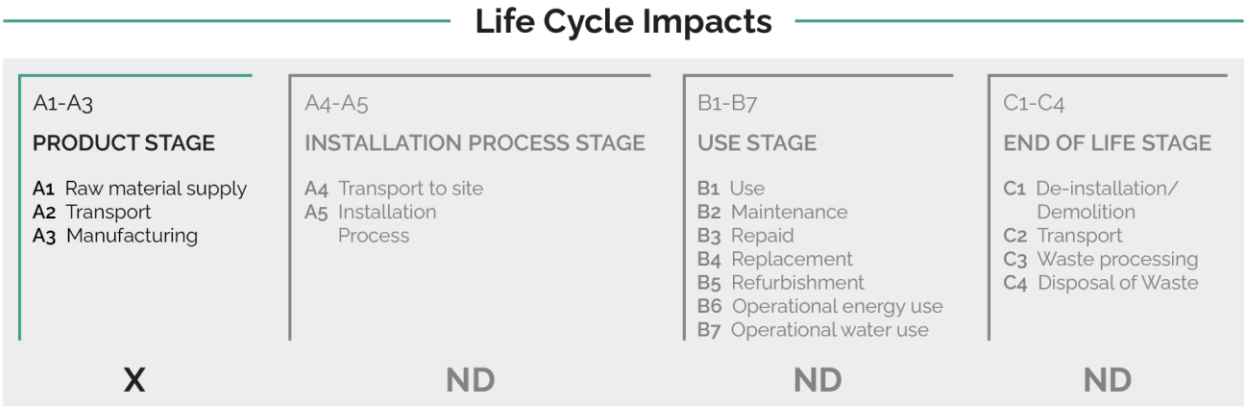

Figure 1: **General life cycle phases for consideration in a construction works system**

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.

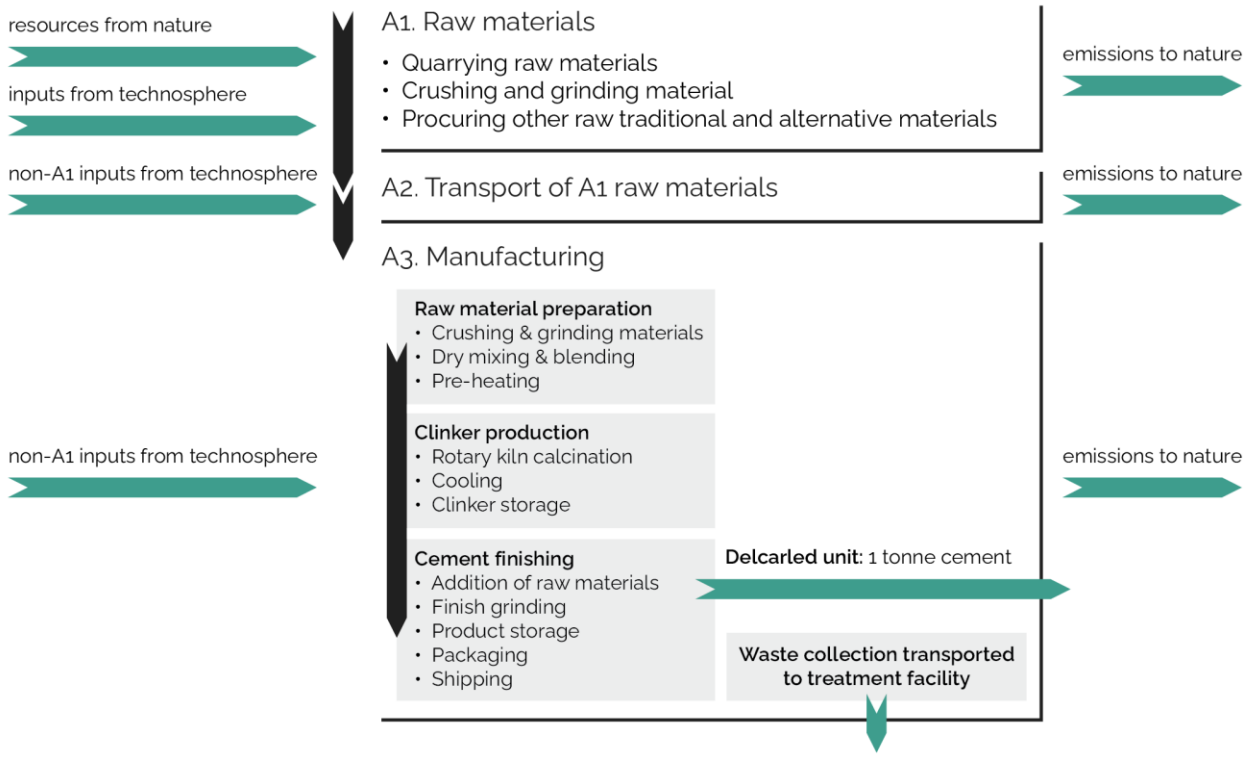

Figure 2: **General system inputs considered in the product system and categorized by modules in scope**

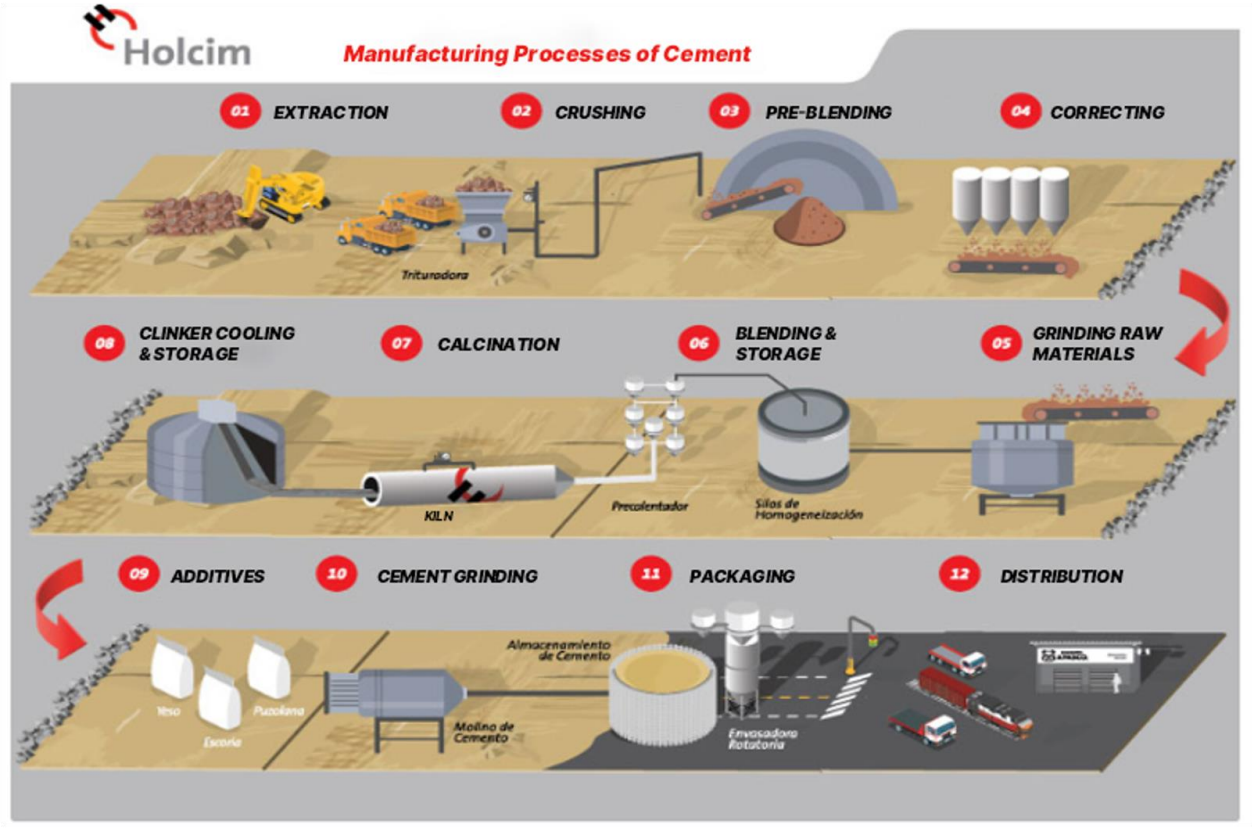

Figure 3: **Manufacturing process of Holcim cement.**

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

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

For this LCA the manufacturing plant, owned and operated by Holcim México Operaciones SA de CV, is located at their Ramos Arizpe Cement Plant facility in Mexico. All operating data is formulated using the actual data from Holcim México Operaciones SA de CV'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 v3.10 database and a local EPD database in combination with primary data from Holcim México Operaciones SA de CV 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: Electricity generation and consumption values were based on monthly utility bills and Holcim's 2020 GHG emissions reports. This facility uses both CFE, Mexico's main utility and Iberdrola, an alternate energy provider that does not use oil or coal as part of their energy mix. An Iberdrolaspecific process was created with Iberdrola's unique mix. Since they would not release information about their exact energy mix transmitted to cement plant, assumptions were made based on available data on nominal capacities of each generation technology and average annual capacity factors for each energy production type. Further information can be found in the section Additional Information.

Process/space heating: All fuel consumed for process/space heating was accounted for using direct emission calculations. See A3 emissions explanation.

Fuel required for machinery: All on-site machinery emission values used ecoinvent 3.10-unit processes. Diesel has been used for fire system, emergency plant, utility cars, trackmobil and construction machinery apart from that no other type of fuel has been used by the plant.

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

Recovered energy: Not Applicable.

Recycled/reused material/components: All the kiln dust from the cement processing is used as input to other Holcim products and/or processes.

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

Direct A3 emissions accounting: All direct emissions were entered using a hybrid of direct Holcim emissions calculations from their yearly GHG Facility-Level Emissions report and LCI ecoinvent unit processes.

Waste transport requirements: Holcim direct reporting waste and non-hazardous waste we used with default calculations for waste hauling.

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
Fluorite (to make Clinker batch Type 1)	fluorspar production, 97% purity/fluorspar, 97% purity/GLO/kg	ecoinvent v3.10 in 2024	Coahuila	2024	2	3	1	3	3
Coke (to make Clinker batch Type 1)	petroleum coke production, petroleum refinery operation/petroleum coke/RoW/kg	ecoinvent v3.10 in 2024	Coahuila	2024	2	3	1	3	3
Low Gravel (to make Clinker batch Type 1)	limestone quarry operation/limestone, unprocessed/RoW/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.10 in 2024	Coahuila	2024	2	3	2	3	3

Iron Ore (to make Clinker batch Type 1)	iron ore mine operation, 63% Fe/iron ore, crude ore, 63% Fe/IN/kg	ecoinvent v3.10 in 2024	Nuevo León	2024	1	3	0	3	3
Shale (to make Clinker batch Type 1)	market for shale/shale/GLO/kg	ecoinvent v3.10 in 2024	Coahuila	2024	2	3	2	3	3
Coal (to make Clinker batch Type 1)	market for hard coal/hard coal/RoW/kg	ecoinvent v3.10 in 2024	Coahuila	2024	1	3	0	3	3
Natural gas (to make Clinker batch Type 1)	natural gas production/natural gas, high pressure/RoW/m3	ecoinvent v3.10 in 2024	Coahuila	2024	2	3	1	3	3
High aluminum clay (to make Clinker batch Type 1)	refractory production, high aluminium oxide, packed/refractory, high aluminium oxide, packed/RoW/kg	ecoinvent v3.10 in 2024	Coahuila	2024	2	3	2	3	3
Blast Furnace Slag (to make Clinker batch Type 1)	market for granulated blast furnace slag/granulated blast furnace slag/RoW/kg	ecoinvent v3.10 in 2024	Coahuila	2024	1	3	0	3	3
Gypsum	gypsum quarry operation/gypsum, mineral/RoW/kg	ecoinvent v3.10 in 2024	Coahuila	2024	2	3	2	3	3
Diesel	diesel production, petroleum refinery operation/diesel/RoW/kg	ecoinvent v3.10 in 2024	Coahuila	2024	2	3	2	3	3
Recovered Material (to make Clinker batch Type 1)	Waste input produced off-site	See A3 inputs	Coahuila	See A3 inputs	1	A3	1	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 v3.10 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 v3.10 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.

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 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 v3.10 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 5: **Life cycle impact categories and life cycle inventory metrics**

ID	LCIA.indicators	Abbreviations	Units
1	climate change: global warming potential (GWP100)	GWP100	kg CO2-eq
2	ozone depletion: ozone depletion potential (ODP)	ODP	kg CFC-11-eq
3	acidification: acidification potential (AP)	AP	kg SO2-eq
4	eutrophication: eutrophication potential	EP	kg N-eq
5	Smog Formation Potential	SFP	kg O3-eq
6	energy resources: non-renewable: abiotic depletion potential (ADP): fossil fuels	ADPfossil	MJ
Inventory metrics			
7	inventory indicators ISO21930: Cumulative Energy Demand - renewable energy resources	RPRE	MJ
8	inventory indicators ISO21930: Renewable primary resources with energy content used as material (i.e., PERM)	PRM	MJ
9	inventory indicators ISO21930: Cumulative Energy Demand - non-renewable energy resources	NRPRE	MJ
10	inventory indicators ISO21930: Non-renewable primary resources with energy content used as material (i.e., PENRM)	NRPRM	kg
11	inventory indicators ISO21930: use of secondary material	SM	MJ
12	inventory indicators ISO21930: use of renewable secondary fuels	RSF	MJ
13	inventory indicators ISO21930: recovered energy	RE	MJ
14	inventory indicators ISO21930: use of net fresh water	FW	m3
15	inventory indicators ISO21930: hazardous waste disposed	HWD	kg
16	inventory indicators ISO21930: non-hazardous waste disposed	NHWD	kg
17	inventory indicators ISO21930: high-level radioactive waste disposed	HLRW	kg
18	inventory indicators ISO21930: intermediate and low-level radioactive waste disposed	ILLRW	kg
19	inventory indicators ISO21930: materials for recycling	MR	kg
20	inventory indicators ISO21930: materials for energy recovery	MER	kg
21	inventory indicators ISO21930: exported energy - electricity	EEel	MJ
22	inventory indicators ISO21930: exported energy - heat	EEheat	MJ

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 6: **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	GWP100	ODP	AP	EP	SFP	ADPfossil
Unit	kg CO2-eq	kg CFC-11-eq	kg SO2-eq	kg N-eq	kg O3-eq	MJ
Minimum	266	1.13e-06	0.224	0.111	4.03	937
Maximum	764	2.21e-06	0.42	0.239	7.69	2050
Mean	553	1.76e-06	0.335	0.185	6.08	1580
Median	592	1.84e-06	0.349	0.194	6.3	1670
CPC30	492	1.63e-06	0.308	0.169	5.53	1450
CPC40	691	2.06e-06	0.389	0.22	7.06	1890
CPMM	266	1.13e-06	0.224	0.111	4.03	937
CPC40R	764	2.21e-06	0.42	0.239	7.69	2050

b) Resource Inventory Metrics:

Indicator/LCI Metric	RPRE	PRM	NRPRE	NRPRM	SM	RSF	RE	FW
Unit	MJ	MJ	MJ	kg	MJ	MJ	MJ	m3
Minimum	68.4	0.401	67.3	330	0.156	0.00574	0.0728	0.118
Maximum	107	0.401	106	1020	0.32	0.0161	0.169	0.206
Mean	90.9	0.401	89.5	730	0.252	0.0117	0.129	0.168
Median	94	0.401	92.4	784	0.265	0.0124	0.137	0.174
CPC30	86.1	0.401	84.7	645	0.233	0.0104	0.118	0.155
CPC40	102	0.401	100	923	0.297	0.0145	0.156	0.192

CPMM	68.4	0.401	67.3	330	0.156	0.00574	0.0728	0.118
CPC40R	107	0.401	106	1020	0.32	0.0161	0.169	0.206

c) Waste/Output Inventory Metrics:

Indicator/LCI Metric	HWD	NHWD	HLRW	ILLRW	MR	MER	EEel	EEheat
Unit	**kg**	**kg**	**kg**	**kg**	**kg**	**kg**	**MJ**	**MJ**
Minimum	2.48	60.2	0.000104	0.000445	0.0287	2.4e-05	0.0325	0.0402
Maximum	5.98	133	0.000178	0.000712	0.0458	5.83e-05	0.0755	0.093
Mean	4.5	102	0.000147	6e-04	0.0386	4.4e-05	0.0575	0.0711
Median	4.77	108	0.000152	0.00062	0.0399	4.68e-05	0.061	0.0756
CPC30	4.07	93.4	0.000138	0.000567	0.0365	4e-05	0.0525	0.0653
CPC40	5.47	123	0.000167	0.000674	0.0433	5.35e-05	0.0695	0.0858
CPMM	2.48	60.2	0.000104	0.000445	0.0287	2.4e-05	0.0325	0.0402
CPC40R	5.98	133	0.000178	0.000712	0.0458	5.83e-05	0.0755	0.093

ADDITIONAL ENVIRONMENTAL INFO

Emissions

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

Table 7: **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.
CPC30	448	492
CPC40	630	691
CPMM	242	266
CPC40R	696	764

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.