

Environmental Product Declaration



**Environmental Product Declaration for cement products
produced by CTS Cement Manufacturing Corporation at their
CTS Cement Plant facility in Ciudad Juarez**



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ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers cement products produced by CTS. Declared unit: 1 tonne of cement/cement product
Declaration Owner:	CTS Cement Manufacturing Corporation
	12442 Knott Street
	Garden Grove, CA https://www.ctscement.com
Program Operator:	Labeling Sustainability
	Address, 11670 W Sunset Blvd.
	City, State, Los Angeles, CA http://labelinsustainability.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: (<u>Used as a guidance document only</u>) NSF International (March 2020). Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPD) of Portland, Blended, Masonry, Mortar, and Plastic (stucco) Cements. Valid through March 31, 2025.
	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 Way, Suite 611, Knoxville, TN 37931, jgeilbig@ecoform.com .
Independent LCA Reviewer and EPD Verifier:	This EPD was independently verified in accordance with ISO 14025. The life cycle assessment was independently reviewed in accordance ISO 14044 and the referenced PCR.
	Independent verification of the declaration, according to ISO 14025:2006
	Internal <input type="checkbox"/> ; External <input checked="" type="checkbox"/> 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:	11 January 2023
Period of Validity:	5 years; valid until 12 January 2028
EPD Number:	8631a981-7ab4-4c84-b552-5243e37f9648



COMPANY DESCRIPTION

CTS Cement Manufacturing Corporation (CTS) is a trusted source for construction and design professionals who desire cementitious products with high-quality, safe, and durable results. CTS products are the literal building materials for designing, specifying, and building. To see each project through to completion, the materials you choose significantly affect the well-being of future generations.

CTS Founder, and post-tensioning pioneer Edward K. Rice, PE, FACI, set out to improve the way materials were used in building and construction projects. With civil engineering as his expertise and construction as his passion, he developed two cement technologies in use since the 1960s: Type-K shrinkage compensating cement and Rapid Set® cement. As a result, these products have helped construction and design professionals, DOT personnel, and homeowners get outstanding results while saving time and money.

CTS is an employee-owned company.

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://epdregistration.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. This Product Category Rule was used as a guidance document for this study. 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 CTS Cement Manufacturing Corporation 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 CTS Cement Manufacturing Corporation 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 their license to operate in the community. 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 the guidance 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)

The PCR for cement, as listed as the sub-PCR 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 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

Two flagship brands for CTS Cement Manufacturing include Rapid Set® and Komponent®. Rapid Set® is a brand of professional-grade cement products made with Rapid Set® Cement, a calcium sulfoaluminate (CSA) cement technology. Unlike other CSA cements, Rapid Set is a standalone cement that does not require blending or additives to achieve its superior performance. Rapid Set products are engineered for high performance, versatility, low shrinkage, rapid strength gain, and long-lasting results – performance characteristics that save you significant time and money with reduced installation times, labor, and maintenance costs. In addition, Rapid Set gains structural strength in one hour.

Komponent® is a brand of shrinkage-compensating concrete products made with Type K cement technology. These products significantly reduce or eliminate control joints and alleviate curling and cracking due to drying shrinkage. Resolving these inherent issues protects the integrity and durability of the concrete, provides 30-40% greater abrasion resistance, and extends the life expectancy of the installation. In addition, Komponent's high durability prevents common and costly challenges related to concrete deterioration, repair, and structural failure. As a result, this minimizes repairs and maintenance costs, reduces lifecycle costs and maximizes the concrete's sustainability.



PRODUCT STANDARD DEFINITIONS

This EPD reports the impacts for different cement products in accordance with the following standards depending on the final product and region:

- **RapidSet:** A rapid hardening hydraulic cement
- **FastRock 500:** A Calcium Sulfoaluminate mineral additive.
- **Komponent:** Shrinkage-compensating cement additive.

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: All declared products considered in this environmental product declaration

Declared Product	Unique name/ID	Short description	Product type	Clinker content, wt%
1	RapidSet	Rapid hardening hydraulic cement.	Rapid Hardening	90
2	FastRock 500	A calcium sulfoaluminate mineral additive.	Mineral additive	100
3	Komponent	Shrinkage-compensating cement additive.	Cement additive	58

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.



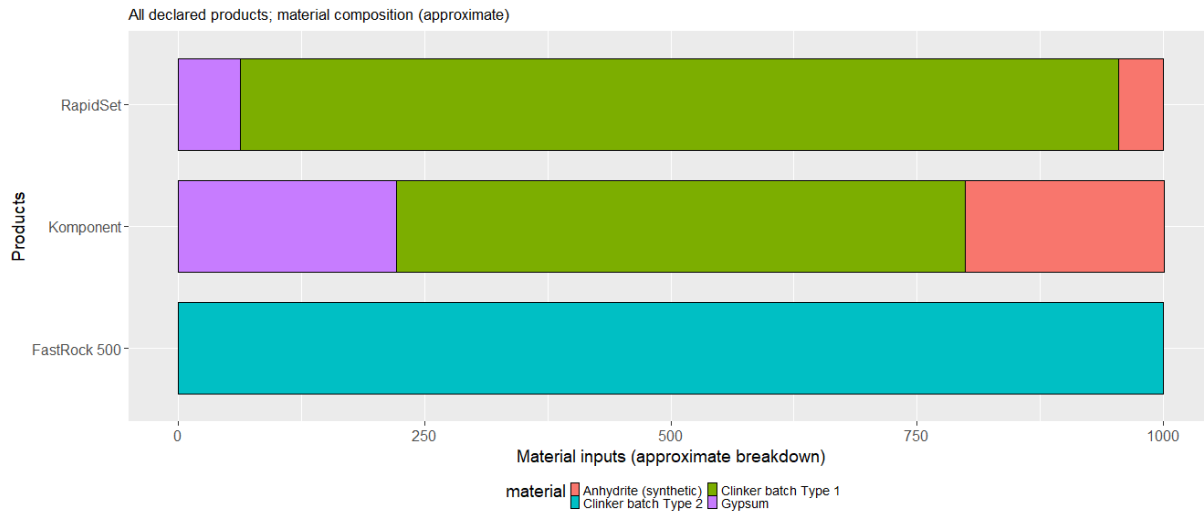


Figure 1: Approximate material composition - All declared products per 1 tonne of cement/cement product. Note: presented breakdown is approximate to ensure confidentiality.

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 2: 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
Coal Fuel	Fuel	1	0	0	0.02
Waste Plastic Fuel	otherEcoinvent	1	0	0	0.02
Waste Oil Fuel	otherEcoinvent	0	0	1	0.02
Wood	otherEcoinvent	0	0	1	0.02
Limestone	otherEcoinvent	0	0	1	0.02
Gypsum	otherEcoinvent	1	0	0	0.02
Limestone	Limestone	0	0	1	0.02
Clay	otherEcoinvent	1	0	0	0.02
Bauxite	otherEcoinvent	1	0	0	0.02
Waste Shells	otherEcoinvent	0	0	1	0.02
Natural gas Fuel	Fuel	1	0	0	0.001
Sandstone	Fine.Aggregate	1	0	0	0.02
Fluorspar	otherEcoinvent	1	0	0	0.02
Clinker batch Type 1	Clinker	1	0	0	0
Clinker batch Type 2	Clinker	1	0	0	0
Gypsum	Gypsum	1	0	0	0.02
Anhydrite (synthetic)	Other mineral	0	0	1	0.02
Propane	otherEcoinvent	1	0	0	0
Diesel	otherEcoinvent	1	0	0	0
Gasoline	otherEcoinvent	1	0	0	0



SYSTEM BOUNDARIES

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

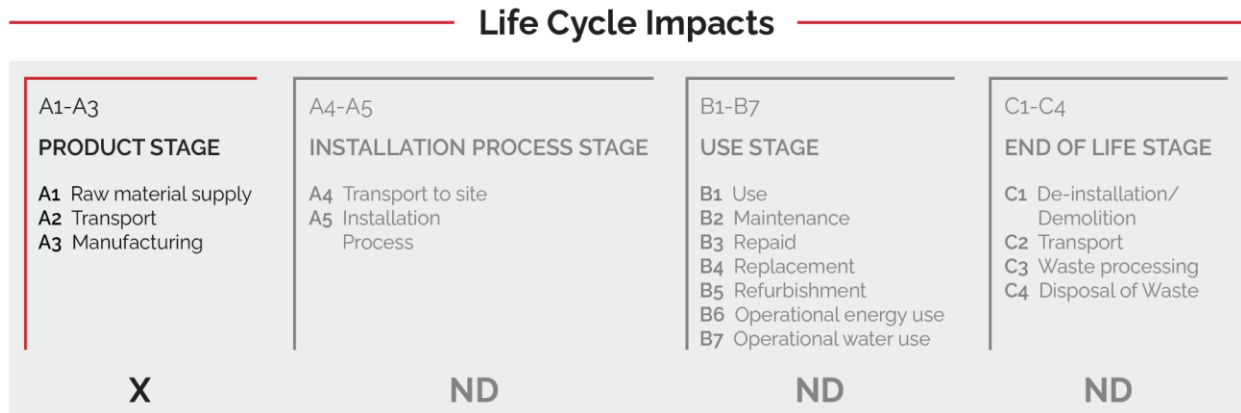


Figure 2: **General life cycle phases for consideration in a construction works system**

This is a Cradle-to-gate life cycle assessment and the following life cycle stages are included in the study:

- A1: Raw material supply (upstream processes) - Extraction, handling, and processing of the materials used in manufacturing the declared products in this LCA.
- A2: Transportation - Transportation of A1 materials from the supplier to the "gate" of the manufacturing facility (i.e. A3).
- A3: Manufacturing (core processes)- The energy and other utility inputs used to store, move, and manufacturer the declared products and to operate the facility.

As according to the PCR, the following figure illustrates the general activities and input requirements for producing cement products and is not necessarily exhaustive.



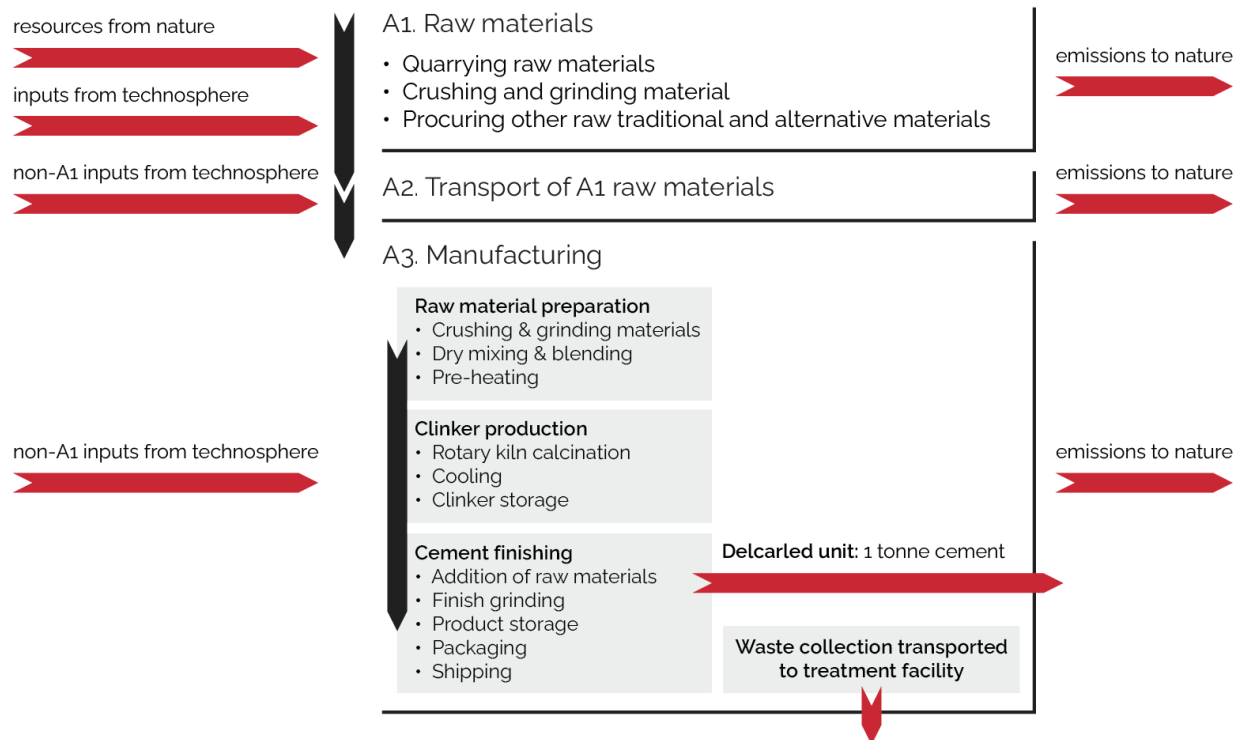


Figure 3: General system inputs considered in the product system and categorized by modules in scope

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

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

For this LCA the manufacturing plant, co-operated by CTS Cement Manufacturing Corporation, is located at their CTS Cement Plant facility. All operating data is formulated using the actual data from CTS Cement Manufacturing Corporation'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 v3.6 database and a local EPD database in combination with primary data from CTS Cement Manufacturing Corporation 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

The following table summarizes the facility's (i.e., A3) electricity consumption and generation (if applicable), process/space heating requirements, fuel inputs for on-site machinery, and waste generation.

Table 3: Inputs required by facility from 2020-01-01 to 2020-12-31 (365 days) to produce 151,085.18 tonne of cement/cement product

Activity	Value	Units
Electricity consumption and generation (if applicable)		
Gross grid electricity:	17,268,435	kWh
Waste generation		
Wash water	0	m3
Hazardous waste	601,153.6	kg
Non-hazardous waste	8,283,790	kg
High-level radioactive waste	0	kg

No recovered on-site energy occurs at this facility.

No re-used or recycled material for utilization on-site or off-site was reported at this facility.

The following statements explain how the above facility requirements/generation were derived:

Raw material transport: A combination of actual mode/distance combinations were assumed for key bulk materials whereasecoinvent default multi-modal market mix distances were assumed for other inputs where no original data could be provided.

Electricity: Electricity generation and consumption values were based on the plant's self-reported energy matrix in their annual report, "REGISTRO DE EMISIONES Y TRANSFERENCIA DE CONTAMINANTES (RETC) PARA ESTABLECIMIENTOS DE JURISDICCION FEDERAL DURANTE 2020". The proportion of electricity, energy used on-site, materials, and fuels entered into the kiln was allotted to this CTS product EPD by the proportion of CTS products produced at this facility. This facility uses CFE, Mexico's main utility provider and grid.

Process/space heating: Process heating values are from the annual report, "REGISTRO DE EMISIONES Y TRANSFERENCIA DE CONTAMINANTES (RETC) PARA ESTABLECIMIENTOS DE JURISDICCION FEDERAL DURANTE 2020". They include fuel processes outside the kiln for moving materials and other non-furnace related operations.

Fuel required for machinery: On-site fuel consumption was also reported using the above-mentioned report. This includes propane, gasoline, and diesel.

Waste generation: Hazardous waste at the plant must be permitted and reported annually. All hazardous waste generation was recorded using the annual government declaration for the plant. Non-hazardous waste was determined from the facility's direct reporting records.

Recovered energy: Not applicable.

Recycled/reused material/components: Due to lack of data, default loss factors were assumed.

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 JURISDICCION FEDERAL DURANTE 2020". In addition, the plant has their emissions third-party verified. The report, INFORME DE VERIFICACION DEL INVENTARIO DE EMISIONES DE COMPUESTOS Y GASES DE EFECTO INVERNADERO 2020 PLANTA JUJUREZ DE ACUERDO CON LOS LINEAMIENTOS DEL REGISTRO NACIONAL DE EMISIONES, was used to record direct emissions for biogenic and fossil carbon.

Waste transport requirements: 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) *Data Quality Assessment- 0= Poor, 1=Fair, 2=Good, and 3= very good.*

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Coal Fuel (to make Clinker batch Type 1)	market for hard coal/hard coal/RoW/kg	ecoinvent v3.6	Chihuahua	v3.6 in 2019	2	2	2	3	3
Clay (to make Clinker batch Type 1)	market for clay/clay/RoW/kg	ecoinvent v3.6	Missouri	v3.6 in 2019	2	2	2	3	3
Limestone (to make Clinker batch Type 1)	limestone production, crushed, washed/limestone, crushed, washed/RoW/kg	ecoinvent v3.6	Chihuahua	v3.6 in 2019	2	2	2	3	3
Natural gas Fuel (to make Clinker batch Type 1)	market for natural gas, high pressure/natural gas,	ecoinvent v3.6	Chihuahua	v3.6 in 2019	2	2	2	3	3



	high pressure/US/m3								
Wood (to make Clinker batch Type 1)	market for waste wood, untreated/waste wood, untreated/RoW/kg	ecoinvent v3.6	Chihuahua	v3.6 in 2019	2	2	2	3	3
Sandstone (to make Clinker batch Type 1)	market for sand/sand/RoW/kg	ecoinvent v3.6	Chihuahua	v3.6 in 2019	2	2	2	3	3
Waste Oil Fuel (to make Clinker batch Type 1)	market for spent solvent mixture/spent solvent mixture/RoW/kg	ecoinvent v3.6	Chihuahua	v3.6 in 2019	2	2	2	3	3
Waste Plastic Fuel (to make Clinker batch Type 1)	market for waste plastic, mixture/waste plastic, mixture/RoW/kg	ecoinvent v3.6	Chihuahua	v3.6 in 2019	2	2	2	3	3
Gypsum (to make Clinker batch Type 1)	gypsum quarry operation/gypsum, mineral/RoW/kg	ecoinvent v3.6	Chihuahua	v3.6 in 2019	2	2	2	3	3
Fluorspar (to make Clinker batch Type 1)	market for fluorspar, 97% purity/fluorspar, 97% purity/GLO/kg	ecoinvent v3.6	Chihuahua	v3.6 in 2019	2	2	2	3	3
Waste Shells (to make Clinker batch Type 1)	market for waste wood, untreated/waste wood, untreated/ME/kg	ecoinvent v3.6	Chihuahua	v3.6 in 2019	0	2	2	3	3
Bauxite (to make Clinker batch Type 1)	market for bauxite/bauxite/GLO/kg	ecoinvent v3.6	Arkansas	v3.6 in 2019	2	2	2	3	3
Diesel	market for diesel/diesel/CO/kg	ecoinvent v3.6	Nuevo Leon	v3.6 in 2019	2	2	2	3	3
Propane	market for propane/propane/GLO/kg	ecoinvent v3.6	Chihuahua	v3.6 in 2019	2	2	2	3	3
Gasoline	market for petrol, unleaded/petrol, unleaded/RER/kg	ecoinvent v3.6	Chihuahua	v3.6 in 2019	2	2	2	3	3
Anhydrite (synthetic)	Produced on-site (A3)	ecoinvent v3.6	Chihuahua	v3.6 in 2019	3	3	3	3	3



Table 5: LCI inputs assumed for module A2 (i.e. transport of A1 inputs) *Data Quality Assessment- 0= Poor, 1=Fair, 2=Good, and 3= very good.*

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Bauxite (to make clinker)-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	1	3	3
Clay (to make clinker)-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	1	3	3
Coal Fuel (to make clinker)-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	1	3	3
Diesel-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	1	3	3
Fluorspar (to make clinker)-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	1	3	3
Gypsum-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	1	3	3
Propane-freight	market for transport, freight, lorry 7.5-16	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	1	3	3



transport via Truck	metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm								
Gypsum-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	1	3	3
Sandstone (to make clinker)-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	1	3	3
Waste Oil Fuel (to make clinker)-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	1	3	3
Waste Shells (to make clinker)-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	1	3	3
Wood (to make clinker)-freight transport via Truck	market for transport, freight, lorry 7.5-16 metric ton, EURO6/transport, freight, lorry 7.5-16 metric ton, EURO6/RoW/tkm	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	1	3	3

Table 6: LCI inputs assumed for module A3 Data Quality Assessment- 0= Poor, 1=Fair, 2=Good, and 3= very good.

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Grid electricity	market for electricity, medium voltage/electricity,	ecoinvent v3.6	MX	v3.6 in 2019	3	2	3	3	3



	medium voltage/MX/kWh; Note: modifications made (seeecoinvent activity changes table)								
Hazardous waste	treatment of hazardous waste, hazardous waste incineration/hazardous waste, for incineration/RoW/kg	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	1	3	3
Non-hazardous waste	treatment of municipal solid waste, sanitary landfill/municipal solid waste/RoW/kg	ecoinvent v3.6	RoW	v3.6 in 2019	1	2	1	3	3
Transport of Hazardous waste	market for transport, freight, lorry, unspecified/transport, freight, lorry, unspecified/RoW/tkm	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	2	3	3
Transport of Non-hazardous waste	market for transport, freight, lorry, unspecified/transport, freight, lorry, unspecified/RoW/tkm	ecoinvent v3.6	RoW	v3.6 in 2019	2	2	2	3	3

The following table depicts every modification undertaken to the ecoinvent activities assumed in the tables above:

Table 7: All Technosphere input changes made to any ecoinvent activities used in the system model

ID	product	updateType	activityName ToChange	name_inputActivity	value	units	explanation
7	Electricity	Remove	market for electricity, medium voltage/electricity, medium voltage/MX/kWh	market for electricity, high voltage/electricity, high voltage/MX/kWh	0	kWh	Regarding activity 'market for electricity, medium voltage/electricity, medium voltage/MX/kWh', the input 'market for electricity, high voltage/electricity, high voltage/MX/kWh', was removed assuming 7.38E-1 kWh





8	Electricity	Add	market for electricity, medium voltage/electricity, medium voltage/MX/kWh	electricity production, photovoltaic, 570kWp open ground installation, multi-Si/electricity, low voltage/MX/kWh	0	kWh	Regarding activity 'market for electricity, medium voltage/electricity, medium voltage/MX/kWh', the input 'electricity production, photovoltaic, 570kWp open ground installation, multi-Si/electricity, low voltage/MX/kWh', was added assuming 1.41E-2 kWh
9	Electricity	Add	market for electricity, medium voltage/electricity, medium voltage/MX/kWh	electricity production, wind, 1-3MW turbine, onshore/electricity, high voltage/MX/kWh	0	kWh	Regarding activity 'market for electricity, medium voltage/electricity, medium voltage/MX/kWh', the input 'electricity production, wind, 1-3MW turbine, onshore/electricity, high voltage/MX/kWh', was added assuming 9.92E-2 kWh
10	Electricity	Add	market for electricity, medium voltage/electricity, medium voltage/MX/kWh	electricity production, natural gas, combined cycle power plant/electricity, high voltage/MX/kWh	0	kWh	Regarding activity 'market for electricity, medium voltage/electricity, medium voltage/MX/kWh', the input 'electricity production, natural gas, combined cycle power plant/electricity, high voltage/MX/kWh', was added assuming 9.92E-2 kWh



report as the specifications and material quantity make-up for the declared products are presented and key primary and secondary LCI data sources are summarized. The provision of more detailed publicly accessible data to allow full external reproducibility was not possible due to reasons of confidentiality.

Label Sustainability has developed a proprietary tool that allows the calculation of PCR-compliant LCA results for Cement product designs. The tool auto-calculates results by scaling base-unit Technosphere inputs (i.e., 1 kg sand, 1 kWh electricity, etc.) to replicate the reference flow conversions that take place in any typical LCA software like openLCA or SimaPro. The tool was tested against several LCAs performed in openLCA and the tool generated identical results to those realized in openLCA across every impact category and inventory metric (where comparisons could be readily made).

Representativeness: The representativeness of the data is summarized as follows.

- Time related coverage of the manufacturing processes' primary collected data from 2020-01-01 to 2020-12-31.
- Upstream (background) LCI data was either the PCR specified default (if applicable) or more appropriate LCI datasets as found in the country-adjusted ecoinvent v3.6 database.
- Geographical coverage for inputs required by the A3 facility(ies) is representative of its region of focus; other upstream and background processes are based on US, North American, or global average data and adjusted to regional electricity mixes when relevant.
- Technological coverage is typical or average and specific to the participating facilities for all primary data.

ENVIRONMENTAL INDICATORS AND INVENTORY METRICS

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

Table 8: Life cycle impact categories and life cycle inventory metrics

ID	LCIA.indicators	Abbreviations	Units
1	environmental impact: acidification	AP	kg SO ₂ eq
2	environmental impact: ecotoxicity	ETP	kg 2,4-D-
3	environmental impact: global warming	GWP	kg CO ₂ -Eq
4	environmental impact: ozone depletion	ODP	kg CFC-11.
5	environmental impact: photochemical oxidation	PCOP	kg O ₃ eq
6	Abiotic Depletion-elements	ADPe	kg Sbeq
7	Abiotic Depletion-fossil fuels	ADPf	kg Sbeq
Inventory metrics			
8	Total primary energy	TPE	MJ-Eq
9	Non-Renewable Resources	NRR	kg
10	Renewable energy	RE	MJ-Eq



11	environmental impact: land filling, bulk waste	LFW	kg waste
12	environmental impact: land filling, hazardous waste	LFHW	kg waste
13	water depletion: WDP	WDP	m3 water-

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.

- Renewable primary energy resources as energy (fuel);
- Renewable primary resources as material;
- Non-renewable primary resources as energy (fuel);
- Non-renewable primary resources as material;
- Secondary Materials;
- Renewable secondary fuels;
- Non-renewable secondary fuels;
- Recovered energy;
- Abiotic depletion potential for non-fossil mineral resources.
- Land use related impacts, for example on biodiversity and/or soil fertility;
- Toxicological aspects;
- Emissions from land use change [GWP 100 (land-use change)];
- Hazardous waste disposed;
- Non-hazardous waste disposed;
- High-level radioactive waste;
- Intermediate and low-level radioactive waste;
- Components for reuse;
- Materials for recycling;
- Materials for energy recovery;
- Recovered energy exported from the product system.

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. This EPD was created using industry-average data for upstream materials.

Table 10: **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**

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H ⁺ -Eq	kg N	kg CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	14.6	0.0119	71.3	6.23e-06	0.145	0.000109	1020
Maximum	62.7	0.0557	728	2.63e-05	0.452	0.0149	2700
Mean	43.7	0.04	483	1.94e-05	0.337	0.00865	2080
Median	48.8	0.0462	567	2.26e-05	0.376	0.00979	2300
RapidSet	55.8	0.0531	673	2.58e-05	0.419	0.0133	2570



FastRock 500	62.7	0.0557	728	2.63e-05	0.452	0.00628	2700
Komponent	41.8	0.0394	461	1.93e-05	0.332	0.0149	2040

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	bioC
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	kg
Minimum	1170	80.6	1060	29.2	7.74e-05	0.249	2.91	0.00077	-0.00772
Maximum	2960	123	2820	161	0.00169	0.438	61.2	0.00496	0.025
Mean	2310	103	2190	102	0.00085	0.356	40.4	0.00346	0.00068
Median	2550	104	2440	108	0.000816	0.368	48.7	0.00406	-0.00728
RapidSet	2850	108	2740	125	0.00097	0.392	58.2	0.00474	-0.00704
FastRock 500	2960	123	2820	161	0.00169	0.438	61.2	0.00496	0.025
Komponent	2250	99.3	2140	91.9	0.000661	0.344	39.2	0.00338	-0.00772

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

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>.

