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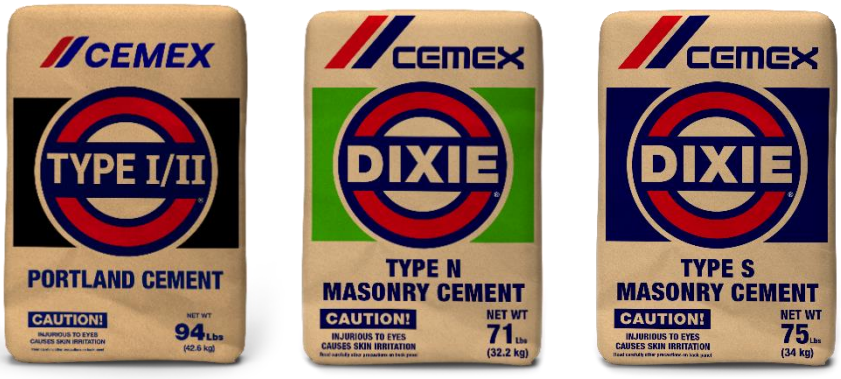
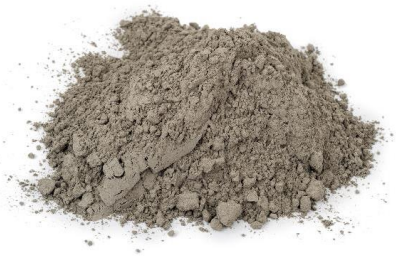
Cemex Knoxville Cement Plant

Environmental Product Declaration





General Information

This cradle to gate Environmental Product Declaration covers bulk and bagged cement products produced at the Knoxville Cement Plant. The Life Cycle Assessment (LCA) was prepared in conformity with ISO 21930, ISO 14025, ISO 14040, and ISO 14044.
This EPD is intended for business-to-business (B-to-B) audiences.

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ISO 21930:2017 Sustainability in Building Construction-Environmental Declaration of Building Products: serves as the core PCR NSF PCR for Portland, Blended, Masonry, Mortar, and Plastic (Stucco) Cements V3.2 serves as the sub-category PCR
Sub-category PCR review was conducted by Thomas P. Gloria, PhD. (t.gloria@industrial-ecology.com) • Industrial Ecology Consultants
Independent verification of the declaration, according to ISO 21930:2017 and ISO 14025:2006.: ☐ internal ☑ external
Third party verifier Thomas P. Gloria, PhD. (t.gloria@industrial-ecology.com) • Industrial Ecology Consultants
For additional explanatory material Manufacture Representative: Anand Krishnan (anand.krishnan@cemex.com) This LCA EPD was prepared by: Melissa Díaz Segura, LCA and EPD Project Manager • Climate Earth (www.climateearth.com)
EPDs are comparable only if they comply with ISO 21930 (2017), use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

General Information

PRODUCER

CEMEX is one of the largest building materials companies in the world with operations in the Americas, the Caribbean, Europe, Africa, Middle East, and Asia. CEMEX employs over 41,000 employees worldwide and is committed to sustainable practices and CO_2 reduction goals in the communities in which it operates. Cemex Knoxville cement plant has been producing high quality products since 1928 and employs about 120 people. The plant has an annual cement production capacity of about 650,000 metric tonnes and provides cement for the construction needs in Tennessee and surrounding states.

PRODUCT

The cement products covered in this EPD meet UN CPC 3744 classification and the following standards:

Product Type	Applicable Standard	Standard Designation
Portland Cement	ASTM C150, C1157, AASHTO M85	Type I/II
Masonry Cement	ASTM C91	Masonry N, Masonry S

This EPD reports environmental information for three cement products produced by CEMEX at its Knoxville TN facility. Type I/II cement is used as the key ingredient in many products such as ready-mix concrete and in a wide array of applications such as concrete pipes, pre-stressed concrete, roads, foundations, bridges, soil stabilization, rooftile and more. Masonry cements are formulated to produce masonry mortar which is used in brick, concrete block, and stone masonry construction. Masonry cements are produced by inter grinding Portland cement with a high limestone content along with additives that provide water repellency and air entrainment.

PRODUCT COMPONENTS

Inputs	Type I/II	Masonry N	Masonry S
Clinker	90.9%	57.4%	64.5%
Limestone, Gypsum & other	9.2%	42.6%	35.5%

DECLARED UNIT

The declared unit is one metric tonne of Type I/II, Masonry N and Masonry S cement.

Life Cycle Assessment

System Boundary

This EPD is a cradle-to-gate EPD covering A1-A3 stages of the life cycle.

PRODUCTION Stage (*Mandatory*)			CONSTRUCTION Stage		USE STAGE					END-OF-LIFE Stage			
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	De-construction/ Demolition	Transport to waste processing or disposal	Waste processing	Disposal of waste
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**C1**	**C2**	**C3**	**C4**
X	**X**	**X**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**
Note: MND = module not declared; X = module included.													

Cut-Off

Items excluded from system boundary include:

- production, manufacture and construction of manufacturing capital goods and infrastructure;
- production and manufacture of production equipment, delivery vehicles, and laboratory equipment;
- personnel-related activities (travel, furniture, and office supplies); and
- energy and water use related to company management and sales activities that may be located either within the factory site or at another location.

Allocation Procedure

Allocation follows the requirements and guidance of ISO 14044:2006, Clause 4.3.4; NSF PCR:2021; and ISO 21930:2017 section 7.2. Recycling and recycled content is modeled using the cut-off rule.

This sub-category PCR recognizes copper slag, cement kiln dust, and aluminium slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a cement material input.

Life Cycle Inventory (LCI)

Primary sources of LCI Data:

Coal: ecoinvent 3.8 (2021): "Hard coal {RNA}| hard coal mine operation and hard coal preparation"
Electricity: US-EI (2021) "Electricity, high voltage, at grid, eGrid (2021), SERC/US US-EI U"
Limestone: Manufacture specific primary data (2021)
Truck transport: USLCI (2015) "Transport, combination truck, long-haul, diesel powered, Central /tkm/RNA"
Truck transport: USLCI (2015) "Transport, combination truck, short-haul, diesel powered, Central /tkm/RNA"

Electricity grid mix includes: 45.83% Natural Gas, 3.21% Hydro, 20.64% Coal, 0.73% Wind, 24.36% Nuclear, 2.31% Solar, 0.0% Geothermal, 1.95% Biomass, 0.46% oil, 0.34% Other Fossil, with a global warming potential of 0.606 kg CO_2eq per /kWh.

Life Cycle Assessment

Knoxville Cement Products[1], bulk shipped: Type I/II, Masonry N and Masonry S per 1 metric tonne.

Impact Assessment	Unit	Type I/II	Masonry N	Masonry S
Global warming potential (GWP)[2]	kg CO_2 eq	881	572	638
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC-11 eq	1.40E-05	9.47E-06	1.04E-05
Eutrophication potential (EP)	kg N eq	1.25	8.12E-01	9.04E-01
Acidification potential of soil and water sources (AP)	kg SO_2 eq	1.52	1.02	1.13
Formation potential of tropospheric ozone (POCP)	kg O_3 eq	32.6	21.5	23.9
Resource Use				
Abiotic depletion potential for non-fossil mineral resources (ADPelements)*	kg Sb eq	9.16E-06	7.04E-06	7.53E-06
Abiotic depletion potential for fossil resources (ADPfossil)	MJ, NCV	4,845	3,282	3,623
Renewable primary energy resources as energy (fuel), (RPRE[3]) *	MJ, NCV	72.7	55.7	59.2
Renewable primary resources as material, (RPRM[2]) *	MJ, NCV	0.00E+00	0.00E+00	0.00E+00
Non-renewable primary resources as energy (fuel), (NRPRE[2]) *	MJ, NCV	5,420	3,723	4,092
Non-renewable primary resources as material, (NRPRM[2]) *	MJ, NCV	0.00E+00	0.00E+00	0.00E+00
Consumption of fresh water, (FW[2])	m^3	2.23	1.69	1.82
Secondary Material, Fuel and Recovered Energy				
Secondary Materials, (SM[2]) *	kg	0.00E+00	0.00E+00	0.00E+00
Renewable secondary fuels, (RSF[2]) *	MJ, NCV	0.00E+00	0.00E+00	0.00E+00
Non-renewable secondary fuels (NRSF[2]) *	MJ, NCV	0.00E+00	0.00E+00	0.00E+00
Recovered energy, (RE[2]) *	MJ, NCV	0.00E+00	0.00E+00	0.00E+00
Waste & Output Flows				
Hazardous waste disposed, (HW[2]) *	kg	3.55E-04	2.93E-04	3.06E-04
Non-hazardous waste disposed, (NHWD[2]) *	kg	1.45	1.20	1.25
High-level radioactive waste, (HLRW[2]) *	kg	3.12E-07	2.38E-07	2.53E-07
Intermediate and low-level radioactive waste, (ILLRW[2]) *	kg	1.55E-06	1.18E-06	1.26E-06
Components for reuse, (CRU[2]) *	kg	0.00E+00	0.00E+00	0.00E+00
Materials for recycling, (MR[2]) *	kg	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery, (MER[2]) *	kg	0.00E+00	0.00E+00	0.00E+00
Recovered energy exported from the product system, (EE[2]) *	MJ, NCV	0.00E+00	0.00E+00	0.00E+00
Additional Inventory Parameters for Transparency				
CO_2 emissions from calcination and uptake from carbonation[4]	kg CO_2 eq	489	309	347

* 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 these categories. Use caution when interpreting data in these categories.
The following optional indicators are not reported and also have high levels of uncertainty: Land use related impacts, toxicological aspects, and emissions from land use change.
Only EPDs prepared from cradle-to-grave life-cycle results and based on the same function, quantified by the same functional unit, and taking account of replacement based on the product reference service life (RSL) relative to an assumed building service life, can be used to assist purchasers and users in making informed comparisons between products.

[1] These products contain no materials that are considered hazardous as defined by the PCR.
[2] GWP 100; 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5).
CO2 from biogenic secondary fuels used in kiln are climate-neutral (CO2 sink = CO2 emissions), ISO 21930, 7.2.7.
[3] Calculated per ACLCA ISO 21930 Guidance.
[4] Calcination emissions were calculated based on the Cement CO2 and Energy Protocol detailed output method (B1) published by the World Business Council for Sustainable Development (WBCSD) Cement Sustainability Initiative (CSI).

LIFE CYCLE ASSESSMENT

Knoxville Cement Products[5], bagged shipped: Type I/II, Masonry N and Masonry S per 1 metric tonne.**

Impact Assessment	Unit	Type I/II	Masonry N	Masonry S
Global warming potential (GWP)[6]	kg CO_2 eq	888	595	655
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC-11 eq	1.44E-05	1.06E-05	1.13E-05
Eutrophication potential (EP)	kg N eq	1.26	8.54E-01	9.37E-01
Acidification potential of soil and water sources (AP)	kg SO_2 eq	1.56	1.12	1.21
Formation potential of tropospheric ozone (POCP)	kg O_3 eq	33.2	22.56	24.79
Resource Use				
Abiotic depletion potential for non-fossil mineral resources (ADPelements)*	kg Sb eq	1.21E-05	1.03E-05	1.07E-05
Abiotic depletion potential for fossil resources (ADPfossil)	MJ, NCV	4948	3,580	3,858
Renewable primary energy resources as energy (fuel), (RPRE[7]) *	MJ, NCV	272	267	267
Renewable primary resources as material, (RPRM[2]) *	MJ, NCV	0.00E+00	0.00E+00	0.00E+00
Non-renewable primary resources as energy (fuel), (NRPRE[2]) *	MJ, NCV	5548	4,151	4,422
Non-renewable primary resources as material, (NRPRM[2]) *	MJ, NCV	0.00E+00	0.00E+00	0.00E+00
Consumption of fresh water, (FW[2])	m^3	3.67	3.41	3.45
Secondary Material, Fuel and Recovered Energy				
Secondary Materials, (SM[2]) *	kg	0.00E+00	0.00E+00	0.00E+00
Renewable secondary fuels, (RSF[2]) *	MJ, NCV	0.00E+00	0.00E+00	0.00E+00
Non-renewable secondary fuels (NRSF[2]) *	MJ, NCV	0.00E+00	0.00E+00	0.00E+00
Recovered energy, (RE[2]) *	MJ, NCV	0.00E+00	0.00E+00	0.00E+00
Waste & Output Flows				
Hazardous waste disposed, (HW[2]) *	kg	3.55E-04	2.93E-04	3.06E-04
Non-hazardous waste disposed, (NHWD[2]) *	kg	1.45	1.20	1.25
High-level radioactive waste, (HLRW[2]) *	m^3	3.25E-07	3.08E-07	3.04E-07
Intermediate and low-level radioactive waste, (ILLRW[2]) *	m^3	1.62E-06	1.52E-06	1.50E-06
Components for reuse, (CRU[2]) *	kg	0.00E+00	0.00E+00	0.00E+00
Materials for recycling, (MR[2]) *	kg	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery, (MER[2]) *	kg	0.00E+00	0.00E+00	0.00E+00
Recovered energy exported from the product system, (EE[2]) *	MJ, NCV	0.00E+00	0.00E+00	0.00E+00
Additional Inventory Parameters for Transparency				
CO_2 emissions from calcination and uptake from carbonation[8]	kg CO_2 eq	489	309	347

*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 these categories. Use caution when interpreting data in these categories.

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[7] Calculated per ACLCA ISO 21930 Guidance.
[8] Calcination emissions were calculated based on the Cement CO2 and Energy Protocol detailed output method (B2) published by the World Business Council for Sustainable Development (WBCSD) Cement Sustainability Initiative (CSI).

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Additional Environmental Information

To learn more about the importance of sustainability at Cemex, please visit:
www.cemex.com/sustainability/future-in-action and www.cemexusa.com/sustainability