



KEYSTONE

CEMENT



An Environmental Product Declaration



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About this EPD

This is a cradle-to-gate environmental product declaration (EPD) for portland, blended and masonry cements as produced by Keystone Cement Company at its Bath, Pennsylvania plant. The results of the underlying LCA are computed with the North American (N.A.) version of the Global Cement and Concrete Association (GCCA) Industry EPD tool for cement and concrete [1]. This tool and the underlying LCA model and database [2] have been previously verified to conform to the prevailing Sub-Product Category Rule (PCR) [3], ISO 21930:2017 (the core PCR) [4] as well as ISO 14020:2000 [5] ISO 14025:2006 [6] and ISO 14040/44:2006 LCA standards [7], [8].

This EPD is certified by ASTM to conform to the PCR referenced above, as well as to the requirements of ISO 14020, ISO 14025, ISO 21930 and ASTM International's General Program Instructions [9]. This EPD is intended for business-to-business audiences.

General Summary

EPD Commissioner and Owner



Keystone Cement Company

6507 Nor Bath
Bath, PA 18014
<https://www.giantcement.com>

The Keystone Cement Company plant provided both LCI and meta-data for limestone extraction, clinker production, and cement manufacture for reference year 2022.

The owner of the declaration is liable for the underlying information and evidence.

Product Group and Name

Cement, UN CPC 3744.

Product Definition

Portland cement is defined as a hydraulic cement produced by pulverizing clinker, consisting essentially of crystalline hydraulic calcium silicates, and usually containing one or more of the following: water, calcium sulfate, up to 5% limestone, and processing additions (ASTM C150 [10], ASTM C219 [11]).

Portland Cement *Type I*—For use when the special properties specified for any other type are not required.

Portland Cement *Type II*—For general use, more especially when moderate sulfate resistance is desired.

Portland Cement *Type III*—For use when high early strength is desired. Some cements are designated with a combined type classification, such as Type I/II, indicating that the cement meets the requirements of the indicated types and is being offered as suitable for use when either type is desired.



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Blended cement is a hydraulic cement consisting of two or more inorganic constituents (at least one of which is not portland cement or portland cement clinker) which separately or in combination contribute to the strength gaining properties of the cement, (made with or without other constituents, processing additions and functional additions, by intergrinding or other blending).

- Type IL (ASTM C595 [12]) — is a portland-limestone cement and is a hydraulic cement in which the limestone content is more than 5% but less than or equal to 15% by mass of the blended cement

Masonry cement is hydraulic cement manufactured for use in mortars for masonry construction or in plasters, or both, which contains a plasticizing material and, possibly, other performance-enhancing addition(s).

Mortar cements are produced in Type N, Type S, and Type M classifications for use in preparation of ASTM Specification C270 [13].

Product Category Rules (PCR)

NSF International, Product Category Rules for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements, V3.2, September 2021 [3].

Date of Issue & Validity Period

08/31/2023 – 5 years

Declared Unit

1 metric ton of cement

EPD and Project Report Information

Program Operator

ASTM International

Declaration Number

EPD 561

Declaration Type

Cradle-to-gate (modules A1 to A3). Facility and product-specific.

Applicable Countries

United States

Product Applicability

Portland cement is the basic ingredient of concrete. Concrete, one of the most widely used construction materials in the world, is formed when portland cement creates a paste with water that binds with sand and rock to harden.

Content of the Declaration

This declaration follows Section 9; Content of an EPD, NSF International, Product Category Rules for Preparing an Environmental



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Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements, V3.2, September 2021 [3].

This EPD was independently verified by ASTM in accordance with ISO 14025 and the reference PCR:

Tim Brooke
ASTM International
100 Barr Harbor Drive
PO Box C700
West Conshohocken
PA 19428-2959, USA
cert@astm.org

Thomas P. Gloria, Ph. D.
Industrial Ecology Consultants
35 Bracebridge Rd.
Newton, MA

Internal **External X**

Notes

The EPD results reported herein are computed using the N.A. GCCA Industry EPD tool for Cement and Concrete (<https://concrete-epd-tool.org>).

EPD Prepared by:



Athena
Sustainable Materials
Institute

Athena Sustainable Materials Institute
280 Albert Street, Suite 404
Ottawa, Ontario, Canada K1P 5G8
info@athenasmi.org
www.athenasmi.org

PCR Information

Program Operator

NSF International

Reference PCR

Product Category Rules for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements, V3.2, September 2021 [3].

PCR review was conducted by:

Thomas P. Gloria, PhD (Chair), Industrial Ecology Consultants,
Mr. Jack Geibig, EcoForm
Mr. Bill Stough, Sustainable Research Group

Keystone Cement Company & Production Facility

Keystone Cement Company has been producing high quality portland cement since 1928. Keystone Cement Company modernized its operations in 2009 with a new finish mill, raw mill, preheater/precalciner kiln system and cooler, and operates the most modern cement plant in Pennsylvania. The plant modernization decreased energy consumption, decreased emissions, and increased production efficiency. Further improvements were completed in 2021 when the Keystone Cement Company plant was converted from coal to natural gas. Its portland cement products have been used by its customers in the Mid-Atlantic for many projects such as the Villanova University dormitories, Children's Hospital of Philadelphia, and Ocean City Municipal Airport runway in Maryland. Keystone Cement Company currently employs over 137 Pennsylvania residents and contributes regularly to support and bolster the local communities in which the company operates. Keystone Cement Company aligns its values with those of the World Business



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Council for Sustainable Development and the Global Cement and Concrete Association by ensuring that its operations are sustainable for current and future generations. Keystone Cement Company minimizes the impact of its operations on its neighbors and focuses on operating in an environmentally ethical manner. Additionally, Keystone Cement Company conserves natural resources by recycling its by-products and making them into usable products. Keystone Cement Company also recovers energy from recycled, alternative fuels, which replaces a portion of the fossil fuel usage. The health and safety of employees is vital to the Plant's success as Keystone Cement Company strives for zero harm.

Facility Name: **Keystone Cement Company**
Keystone Cement Company Plant
6507 Nor Bath Blvd
Bath, PA 18014

Product Description

This EPD reports environmental transparency information for five cement types produced by Keystone Cement Company at its Bath, PA plant. Cements are hydraulic binders and are manufactured by grinding cement clinker and other main or minor constituents into a finely ground, usually grey colored mineral powder. When mixed with water, cement acts as a glue to bind together the sand, gravel or crushed stone to form concrete, one of the most durable, resilient and widely used construction materials in the world. The Table below sets out each cement type constituents and applicable standards. Type I/IA and III cements share the same formula but may be produced to a different blaine and or include an air entrainment admixture (IA). Cements are primarily sold packaged.

Products and Standards

Inputs	Portland Type I/IA/III ASTM C150	Blended Type IL ASTM C595	Masonry ASTM C270
Clinker	93%	83%	62%
Gypsum	7%	7%	4%
Limestone		10%	34%
Other	<1%	<1%	<1%
Total	100%	100%	100%

Applicable Standards:

- ASTM C150 / C150M – 20 Standard Specification for Portland Cement
- ASTM C270 – 19 Standard Specification for Mortar for Unit Masonry
- ASTM C595 / C595M – 20 Standard Specification for Blended Hydraulic Cement
- AASHTO M 85-20 Standard Specification for Portland Cement (ASTM Designation: C150 / C150M - 20)

Declared Unit

The declared unit is one metric ton of cement.

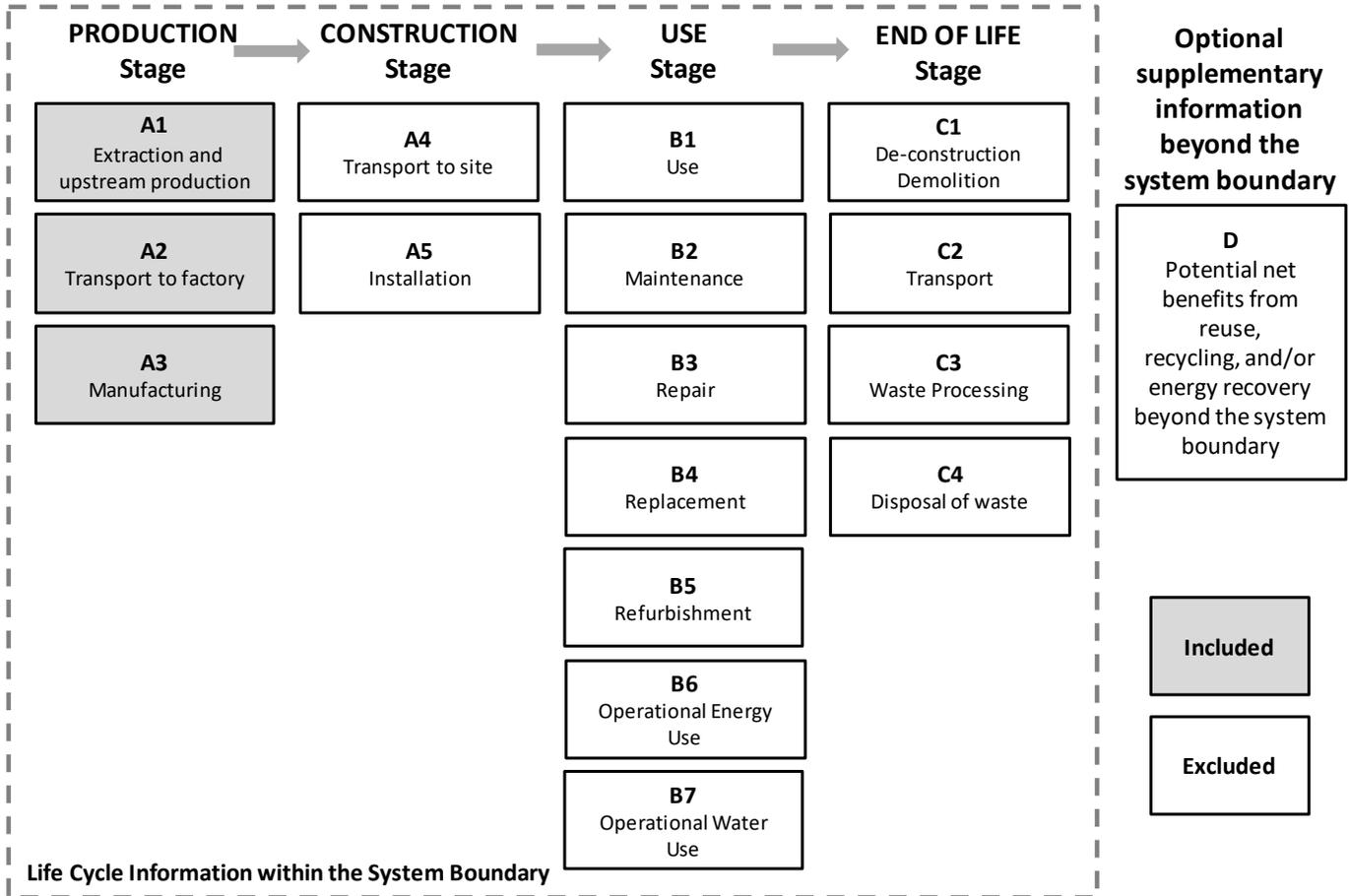


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System Boundary

This is a cradle-to-gate EPD covering the production stage (A1-A3) as depicted in the figure below. The production stage includes extraction of raw materials (cradle) through the manufacture of cements ready for shipment (gate). The Keystone Cement Company plant sources its limestone supply from its adjacent quarry.



Items *excluded* from the 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)
- Energy and water use related to company management and sales activities that may be located either within the factory site or at another location

Cut-off Criteria

The cut-off criteria as per NSF PCR, Section 7.1.8 [3] and ISO 21930, 7.1.8 [4] were followed. Per ISO 21930, 7.1.8, all input/output data required were collected and included in the LCI modelling. No substances with hazardous and toxic properties that pose a concern for human health and/or the environment were identified in the framework of this EPD.

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Data Collection

Gate-to-gate input/output flow data were collected for the following processes for the reference year 2022:

- Limestone quarry operations, clinker production, and cement manufacture.

Allocation Rules

Allocation of inventory flows and subsequent environmental impact is relevant when assets are shared between product systems. The allocation method prescribed by the PCR [3] is applied in the underlying LCA model. The sub-category PCR recognizes fly ash, furnace bottom ash, bypass dust, mill scale, polluted soils, spent catalyst, aluminum oxide waste, silica fume, granulated blast furnace slag, iron rich waste, cement kiln dust (CKD), flue gas desulfurization (FGD) gypsum, calcium fluoride rich waste and postconsumer gypsum as recovered materials and thus, the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a cement material input. Further, used tires, plastics, solvents, used oil and oily waste, coal/carbon waste, roofing asphalt, household refuse-derived waste, non-hazardous liquid waste, industrial sludge, and agricultural waste are considered non-renewable and/or renewable secondary fuels. Only the materials, water, energy, emissions, and other elemental flows associated with reprocessing, handling, sorting and transportation from the point of the generating industrial process to their use in the production process are considered. All emissions from combustion at the point of use are considered. For co-products, no credit is considered, and no allocation is applied. See the LCA model and LCA database reports of the N.A. version of GCCA's Industry Tool for EPDs of cement and concrete for more information [1 & 2].

Data Quality Requirements and Assessment

Data Quality Requirements	Description
Technology Coverage	Data represents the prevailing technology in use at the Keystone Cement Company plant. Whenever available, for all upstream and core material and processes, North American typical or average industry LCI datasets were utilized. The Keystone Cement Company plant utilizes <i>a dry with preheater and precalciner kiln technology</i> . <i>Technological representativeness is characterized as "high".</i>
Geographic Coverage	The geographic region considered is U.S. <i>Geographical representativeness is characterized as "high".</i>



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Data Quality Requirements	Description
Time Coverage	<p>Activity (primary) data are representative of 2022 calendar year (12 months).</p> <ul style="list-style-type: none"> - Keystone limestone extraction, - Keystone clinker production, - Keystone cement manufacturing, - In-bound/out-bound transportation data - primary data collected for quarry site and cement manufacturing plant. <p><i>Temporal representativeness is characterized as “high”.</i></p>
Completeness	<p>All relevant, specific processes, including inputs (raw materials, energy and ancillary materials) and outputs (emissions and production volume) were considered and modeled in the GCCA Tool to complete production profile for Keystone Cement Company cement products. The Keystone Cement Company plant operates a continuous emissions monitoring system and reports emissions to the US EPA. These data for 2022 were drawn on in the completion of this EPD. The completeness of the foreground process chain in terms of process steps is rigorously assessed.</p>
Consistency	<p>To ensure consistency, cross checks of the energy demand and the calculated raw meal to clinker ratio against ranges reported in the WBCSD Cement Sustainability Initiative, Cement CO2 and Energy Protocol, v3.1 December, 2013 were conducted [14]. The LCA team conducted mass and energy balances at the facility level and selected process levels to maintain a high level of consistency.</p>
Reproducibility	<p>External reproducibility is not possible as the source LCI data and subsequent LCA background reports are confidential.</p>
Transparency	<p>Activity datasets are disclosed in the project LCI compilation, and the background reports generated by the GCCA Tool.</p>
Uncertainty	<p>A <i>sensitivity check</i> was conducted relative to the PCA industry average [15]. The variation across significant inputs were found to be well within the expected range and hence, there is high degree of confidence in the results.</p>

Life Cycle Impact Assessment Results: Keystone Cement Company Plant

This section summarizes the production stage life cycle impact assessment (LCIA) results including resource use and waste generated metrics based on the cradle-to-gate life cycle inventory inputs and outputs analysis. The results are calculated based on 1 metric ton of each cement type as produced at the Keystone Cement Company plant.

It should be noted that LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks [4], [5]. Further, many LCA impact categories and inventory items are still emerging or under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting results for these categories – identified with an “*” [3].

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



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life (RSL) relative to an assumed building service life, can be used to assist purchasers and users in making informed comparisons between products [3]. Environmental declarations from different programs may not be comparable [8]. EPDs are comparable only if they comply with ISO 21930, 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 [3].

Production stage EPD Results – per metric ton

Impact category and inventory indicators	Unit	Portland Type I/II/III ASTM C150	Blended Type II ASTM C595	Masonry ASTM C270
Global warming potential, GWP 100, AR5	kg CO2 eq	967	863	658
Ozone depletion potential, ODP	kg CFC-11 eq	2.5E-05	2.3E-05	1.9E-05
Smog formation potential, SFP	kg O3 eq	9.76	9.27	8.24
Acidification potential, AP	kg SO2 eq	1.1	1.0	0.9
Eutrophication potential, EP	kg N eq	0.8	0.8	0.7
Abiotic depletion potential for non-fossil mineral resources, ADP elements*	kg Sb eq	1.3E-04	1.3E-04	1.1E-04
Abiotic depletion potential for fossil resources, ADP fossil*	MJ LHV	4638	4218	3381
Renewable primary resources used as an energy carrier (fuel), RPRE*	MJ LHV	118	115	109
Renewable primary resources with energy content used as material, RPRM*	MJ LHV	151	151	151
Non-renewable primary resources used as an energy carrier (fuel), NRPRE*	MJ LHV	4638	4218	3381
Non-renewable primary resources with energy content used as material, NRPRM*	MJ LHV	0.1	0.1	0.1
Secondary materials, SM*	kg	24.9	1.4	17.8
Renewable secondary fuels, RSF *	MJ LHV	0	0	0
Non-renewable secondary fuels, NRSF *	MJ LHV	631	560	420
Recovered energy, RE*	MJ LHV	0	0	0
Consumption of freshwater, FW*	m3	0.8	0.7	0.6

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Hazardous waste disposed, HWD*	kg	0.1	0.1	0.1
Non-hazardous waste disposed, NHWD *	kg	2.7	2.4	1.9
High-level radioactive waste, conditioned, to final repository, HLRW*	kg	x ¹⁾	x ¹⁾	x ¹⁾
Intermediate- and low-level radioactive waste, conditioned, to final repository, ILLRW*	kg	x ¹⁾	x ¹⁾	x ¹⁾
Components for re-use, CRU*	kg	0	0	0
Materials for recycling, MFR*	kg	0.03	0.03	0.02
Materials for energy recovery, MER*	kg	0	0	0
Recovered energy exported from the product system, EE*	MJ LHV	0	0	0
Global warming potential - biogenic, GWPbio*	kg CO ₂ eq	-15.8	-15.8	-15.8
Emissions from calcination*	kg CO ₂ eq	491	436	327
Emissions from combustion of waste from renewable sources*	kg CO ₂ eq	0	0	0
Emissions from combustion of waste from non-renewable sources*	kg CO ₂ eq	54.9	48.7	36.5

Table Notes:

x¹⁾ – The GCCA EPD Tool does not support these indicators.

* Use caution when interpreting results for these categories

LCA Interpretation

The Manufacturing module (A3) drives most of the potential environmental impacts. Manufacturing impacts are primarily driven by energy use (electricity and thermal fuels) during the pyroprocessing of limestone in the production of clinker. Clinker content in cement similarly defines the relative environmental profile of the final cement product. Raw material extraction (A1) is the second largest contributor to the Production stage EPD results, followed by transportation (A2).

Additional Environmental Information

Environmental Protection and Equipment

Keystone Cement Company manufacturing facilities comply with the U.S. Environmental Protection Agency (EPA) regulations, monitor, and report the emissions to air during the manufacturing process as per the following:



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- EPCRA Section 313 Toxic Release Inventory reporting (U.S) <https://www.epa.gov/toxics-release-inventory-tri-program>, accessed 12-2020.

Keystone Cement Company's EMS was developed based on the ISO 14001: 2004 Standards and the EPA Compliance-Focused Environmental Management System Enforcement Agreement Guidance.

Committed to sustainability, the Keystone Cement Company plant co-processes by-product materials by recovering energy from recovered solvents, coal wastes, and used oil to replace some of the fossil fuels and mineral resources used in cement processing.

Air pollution abatement equipment used at the Keystone Cement Company plant consist of high and low temperature baghouses, carbon adsorption system, and a selective noncatalytic reduction system.

References

1. Global Cement and Concrete Association (GCCA) and Portland Cement Association (PCA), *GCCA Industry EPD Tool for Cement and Concrete (V3.0), Users Manual, North American version*, Prepared by Quantis, April 2021. <https://demo.gcca.quantis.solutions/us>
2. Global Cement and Concrete Association (GCCA) 2021. LCA Database, North American version, Prepared by Quantis, April 2021
3. NSF International, Product Category Rule Environmental Product Declarations, PCR for Portland, Blended, Masonry, Mortar, and Plastic (Stucco) Cements, V3.2, September 2021.
4. ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
5. ISO 14020:2000 Environmental labels and declarations — General principles
6. ISO 14025:2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.
7. ISO 14040:2006/Amd1:2020 Environmental management - Life cycle assessment - Principles and framework.
8. ISO 14044:2006/Amd1:2017/Amd2:2020 Environmental management - Life cycle assessment - Requirements and guidelines.
9. ASTM General Program Instructions. V.8.0, April 29, 2020.
10. ASTM C150 / C150M – 20 Standard Specification for Portland Cement.
11. ASTM C219 - Standard Terminology Relating to Hydraulic and Other Inorganic Cements
12. ASTM C595 / C595M - 21 Standard Specification for Blended Hydraulic Cements
13. AASHTO M 85-21 Standard Specification for Portland Cement (ASTM Designation: C150/C150M-21)
14. WBCSD CSI 2013: CO₂ and Energy Protocol Version 3.1 of 9 December 2013. <https://www.cement-co2-protocol.org/en/>
15. Portland Cement Association Environmental Product Declaration – Portland Cement, ASTM International, March 12, 2021. https://www.astm.org/CERTIFICATION/DOCS/634.EPD_for_Portland_Athena_Final_revised_04082021.pdf