



Kamari, Greece Cement Plant

(inclusive of transportation to Essex Cement Company (Newark, NJ), Roanoke Cement Company (Norfolk/Chesapeake, VA), and Titan Florida (Tampa, FL))

An Environmental Product Declaration





An Environmental Product Declaration

In accordance with ISO 14025 and 21930

About this EPD

This is a Type III environmental product declaration (EPD) for Type I-II and IL cements as produced by Titan Cement Company S.A., at its Kamari, Greece plant inclusive of transportation and offloading to three Titan America cement terminals on the US east coast. The results of the underlying LCA are computed using 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] and ISO 14040/44:2006 LCA standards [7], [8]. It should be noted that the Kamari plant's production of Type I-II and IL cements have been previously verified based on the International version of GCCA tool in accordance with "The International EPD System and in accordance with EN 15804:A2 and the c-PCR 001 Cement and Building Lime.

This EPD is certified by ASTM to conform to the sub-Product Category Rule (PCR) referenced above [3], as well as to the requirements of ISO 14020, ISO 14025 [6], 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



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Titan Cement Group company personnel completed the LCA modeling within the GCCA EPD tool (International and N. America versions) in support of this EPD. 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: calcium sulfate, up to 5% limestone, and processing additions (NSF PCR 2021 [10], ASTM C150 [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.

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) — 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.

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 March 27, 2023 – 5 years

Declared Unit 1 metric ton of cement

EPD and Project Report Information

Program Operator ASTM International

Declaration Number EPD 444

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 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:

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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>).

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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

Titan Cement & Production Facility

Titan America, a member of Titan Cement Group, is a leading environmentally and socially-progressive heavy building materials company located in the eastern United States and headquartered in Norfolk, Virginia. In operation since 1902, Titan Cement Group remains a family-led business with a values-oriented, people-focused culture.

The company operates two cement plants in Roanoke, Virginia, and Medley, Florida. It also operates three marine-based cement terminals serving the US east coast. These terminals distribute cements sourced offshore and produced by the Titan Cement Group. This particular EPD pertains to Type I-II and IL cements produced at Titan Cement Group's Kamari plant located in Viotia, Greece and delivered to three of its cement import terminals – Essex Cement Company– port of Newark, NJ, Roanoke Cement Company – port of Chesapeake, VA (Norfolk, VA), and Titan Florida – port of Tampa, FL.

Product Description

This EPD reports environmental transparency information for Type I-II and IL cements produced by the Titan Cement Group and distributed via bulk terminals at the ports of Newark, NJ, Chesapeake, VA, and Tampa, FL. Cements are hydraulic binders and are manufactured by grinding cement clinker and other 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.

Products and Standards

The Kamari plant's Type I-II and IL cements are comparable in make-up to similar products available on the US market and comply with the following standards:

ASTM C150 / C150M –Standard Specification for Portland Cement

ASTM C595 / C595M –Standard Specification for Blended Hydraulic Cement

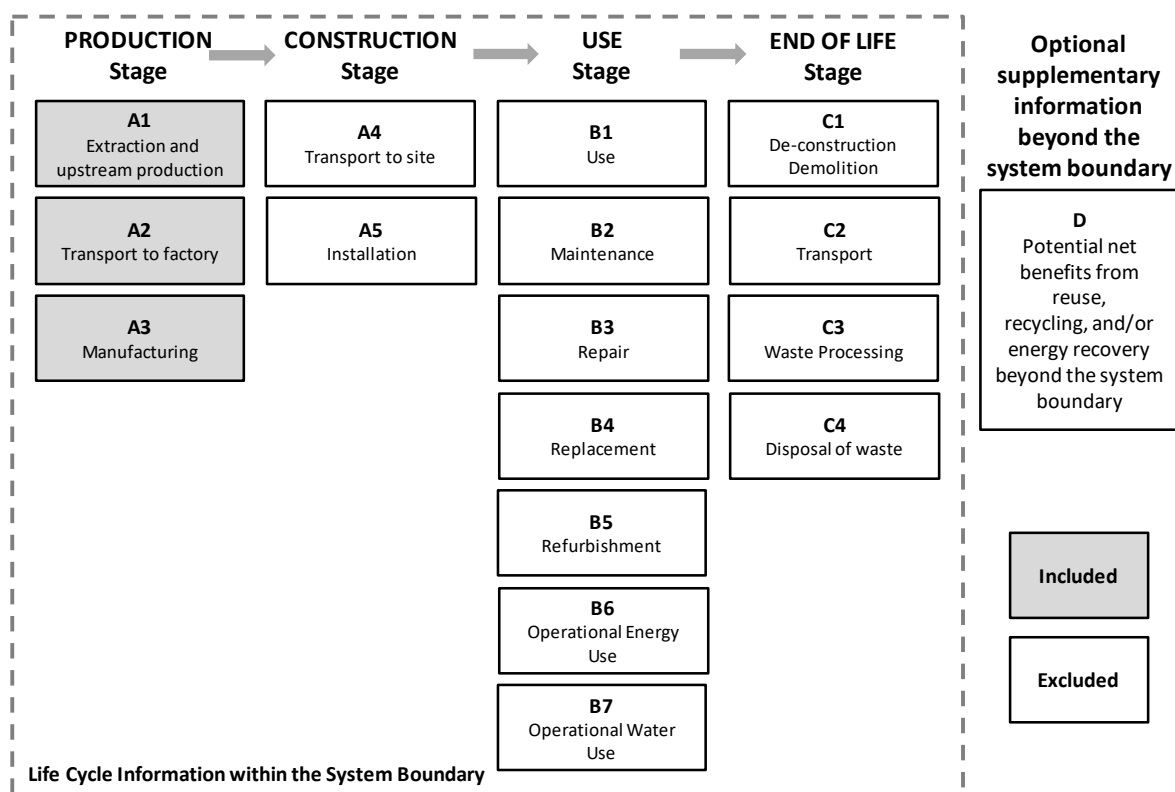
AASHTO M 85 Standard Specification for Portland Cement (ASTM Designation: C150 / C150M - 20)

Declared Unit

The declared unit is one metric ton of cement.

System Boundary

This is a cradle-to-gate EPD covering the production stage (A1-A3) as depicted in the figure below; inclusive of transport to and offloading at three cement import terminals operated by Titan America. The production stage includes extraction of raw materials (cradle) through the manufacture and transport of cements ready for shipment (terminal gate).



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 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

Data Collection

Gate-to-gate input/output flow data were collected for the following processes for the reference year 2020:

- Limestone quarry operations, clinker production and cement manufacture.
- Transport mode and distance from plant to Greece port (truck), Greece port to US port (bulk carrier) and offloading.

Allocation Rules

Allocation of inventory flows and subsequently 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 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	<p>Data represents the prevailing technology in use at the Kamari facility. Whenever available, for all upstream and core material and processes, both International and North American typical or global average industry LCI datasets were utilized.</p> <p>The Kamari plant utilizes a <i>preheater and precalcinator kiln technology</i>. <i>Technological representativeness is characterized as "high"</i>.</p>
Geographic Coverage	<p>The geographic region considered is Global.</p> <p><i>Geographical representativeness is characterized as "high"</i>.</p>

Time Coverage	<p>Activity (primary) data are representative of 2020 and 2021 calendar years (12 months).</p> <ul style="list-style-type: none"> - Kamari clinker production, - Kamari cement manufacturing Type I-II (2020) Type IL (2021), - In-bound/out-bound transportation data - cement manufacturing plant and transport to Essex, Norfolk and Tampa cement import terminals. <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 the production (inclusive of transport and offloading) profile for Titan Group cement products. The cement plant operates a continuous emissions monitoring system and publishes daily and monthly emissions in an open platform. These data for 2020/21 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 [15].</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 [16]. 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: Kamari Plant to Import Terminals

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 Kamari plant inclusive of transportation and offloading at each of the cement terminals.

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], [8]. 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 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 [6]. 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&4].

Production stage EPD Results – per metric ton delivered to import terminals

Impact category and inventory indicators	Unit	Essex Type I/II ASTM C150	Norfolk Type I/II ASTM C150	Tampa Type I/II ASTM C150	Essex Type IL ASTM C595	Norfolk Type IL ASTM C595	Tampa Type IL ASTM C595
Global warming potential, GWP 100, AR5	kg CO2 eq	947	949	957	871	873	881
Ozone depletion potential, ODP	kg CFC-11 eq	3.45E-05	3.49E-05	3.67E-05	3.34E-05	3.38E-05	3.57E-05
Smog formation potential, SFP	kg O3 eq	47.2	47.5	48.8	44.1	44.3	45.6
Acidification potential, AP	kg SO2 eq	3.0	3.1	3.3	2.9	2.9	3.1
Eutrophication potential, EP	kg N eq	0.94	0.95	0.99	0.91	0.92	0.96
Abiotic depletion potential for non-fossil, mineral resources ADP elements*	kg Sb eq	2.29E-04	2.29E-04	2.31E-04	2.22E-04	2.22E-04	2.24E-04
Abiotic depletion potential for fossil resources, ADP fossil*	MJ LHV	393	397	414	382	386	404
Renewable primary resources used as an energy carrier (fuel), RPRE*	MJ LHV	171	172	175	169	170	173
Renewable primary resources with energy content used as material, RPRM*	MJ LHV	0	0	0	0	0	0
Non-renewable primary resources used as an energy carrier (fuel), NRPRE*	MJ LHV	2995	3018	3131	2893	2916	3029
Non-renewable primary resources with energy content used as material, NRPRM*	MJ LHV	0	0	0	0	0	0
Secondary materials, SM*	kg	88.2	88.2	88.2	78.2	78.2	78.2
Renewable secondary fuels, RSF *	MJ LHV	405	405	405	367	367	367
Non-renewable secondary fuels, NRSF *	MJ LHV	849	849	849	770	770	770

Recovered energy, RE*	MJ LHV	0	0	0	0	0	0
Consumption of freshwater, FW*	m3	1.2	1.2	1.2	1.1	1.1	1.2
Hazardous waste disposed, HWD*	kg	0	0	0.0	0	0	0
Non-hazardous waste disposed, NHWD *	kg	0	0	0.0	0	0	0
High-level radioactive waste, conditioned, to final repository, HLRW*	kg	x ¹⁾	x ¹⁾	x ¹⁾	x ¹⁾	x ¹⁾	x ¹⁾
Intermediate- and low-level radioactive waste, conditioned, to final repository, ILLRW*	kg	x ¹⁾	x ¹⁾	x ¹⁾	x ¹⁾	x ¹⁾	x ¹⁾
Components for re-use, CRU*	kg	0	0	0	0	0	0
Materials for recycling, MFR*	kg	1.8	1.8	1.8	1.6	1.6	1.6
Materials for energy recovery, MER*	kg	0	0	0	0	0	0
Recovered energy exported from the product system, EE*	MJ LHV	0	0	0	0	0	0
Global warming potential - biogenic, GWPbio*	kg CO ₂ eq	0.6	0.6	0.6	0.6	0.6	0.6
Emissions from calcination*	kg CO ₂ eq	480	480	480	435	435	435
Emissions from combustion of waste from renewable sources*	kg CO ₂ eq	0.1	0.1	0.1	0.1	0.1	0.1
Emissions from combustion of waste from non-renewable sources*	kg CO ₂ eq	90	90	90	81	81	81

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). It is noted that long distance transport and terminal offloading contributes about 50 to 60kg CO₂e to the overall GWP profile of the imported cements.

Additional Environmental Information

Titan Cement Company S.A. hereby declares that all cement products are in compliance with the REACH Regulation (EC) No 1907/2006, concerning the Registration, Evaluation, Authorization and Restriction of Chemicals. Cement does not contain any Substances of Very High Concern (SVHC) currently on the candidate list. REACH SVHC list is not static and is updated frequently, thus the company will continue to evaluate, research and review to fulfil the demands of the regulation. More information about cement safety handling is available at the Safety Data Sheet (SDS) published at the company's website www.titan.gr.

References

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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
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7. ISO 14040:2006/Amd1:2020 Environmental management - Life cycle assessment - Principles and framework.
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11. ASTM C150 / C150M – 20 Standard Specification for Portland Cement.
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13. ASTM C595 / C595M - 21 Standard Specification for Blended Hydraulic Cements
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16. 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>