# Thailand Cement Plants

**(inclusive of transportation to Sacramento and Oakland, CA, Honolulu, HI, Portland, OR and Seattle, WA)**

*An Environmental Product Declaration*

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## About this EPD

This is a Type III environmental product declaration (EPD) for Type IL cement as produced by SCG International, at two of its plants located in Thailand inclusive of transportation to five ports on the US pacific 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 this EPD reflects the combined production of the two plants.

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

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| **EPD Commissioner and Owner** | SCG International USA Inc.<br>970 West 190th St., Suite 610<br>Torrance, CA 90502, USA<br>https:// www.scginternational.com<br><br>SCG company personnel provided LCI and meta data 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 | ***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).<br>• 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 | November 1, 2023 – 5 years |
| Declared Unit | 1 metric ton of cement |

## EPD and Project Report Information

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| Program Operator | ASTM International |
| Declaration Number | EPD 598 |

# An Environmental Product Declaration

*In accordance with ISO 14025 and 21930*

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| 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:<br><br>Internal External X | Tim Brooke<br>ASTM International<br>100 Barr Harbor Drive<br>PO Box C700<br>West Conshohocken<br>PA 19428-2959, USA<br>cert@astm.org<br><br>Thomas P. Gloria, Ph. D.<br>Industrial Ecology Consultants<br>35 Bracebridge Rd.<br>Newton, MA |
| 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<br>280 Albert Street, Suite 404<br>Ottawa, Ontario, Canada K1P 5G8<br>info@athenasmi.org<br>www.athenasmi.org |

## PCR Information

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| 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,<br>Mr. Jack Geibig, EcoForm<br>Mr. Bill Stough, Sustainable Research Group |

## SCG Cement & Production Facilities

SCG operates a total of five cement plants in Thailand under the Siam Cement Company Ltd. banner. Two plants located in Kaeng Khoi and Kao Wong export Type IL cement to various SCG USA customers. Both of the plants operate efficient preheat, precalciner kiln types. This EPD reflects the combined production of the two plants serving the US market. SCG provides all logistics for cement delivery with customers responsible for off-loading of the bulk cement.

This particular EPD pertains to Type IL cement produced at the two plants and delivered to five port locations – port of Sacramento and Oakland, CA – port of Honolulu, HI – port of Portland, OR and the port of Seattle, WA.

## Product Description

This EPD reports environmental transparency information for Type IL cements. 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

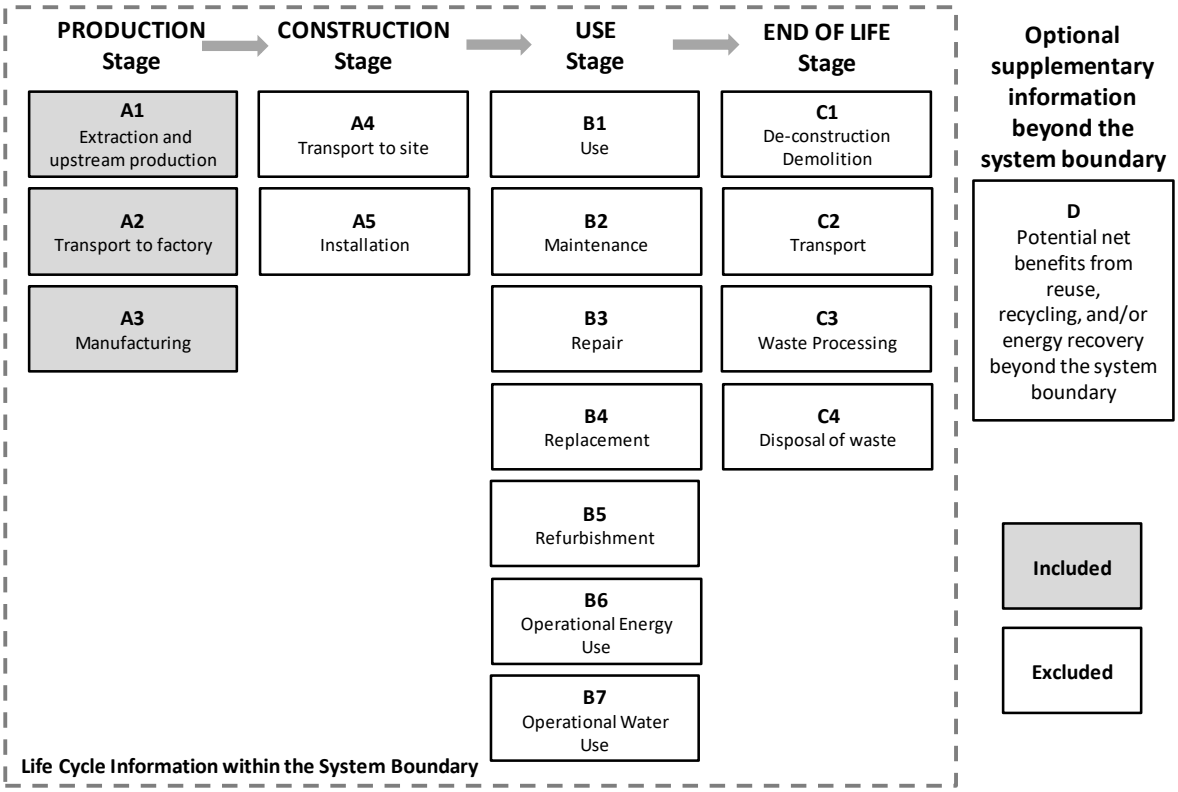
The two plant's Type IL cement is comparable in make-up to similar products available on the US market and comply with the following standard:
ASTM C595 / C595M –Standard Specification for Blended Hydraulic Cement

## 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 four cement import ports operated by SCG US customers. The production stage includes extraction of raw materials (cradle) through the manufacture and transport of cements ready for shipment (gate). Transportation reflects mode and distances from the two plants to Thailand export port and bulk carrier delivery to five US port destinations. Cement off-loading is the responsibility of the receiving customer and as such, off-loading effects are excluded from this EPD.




**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 plants (average) to Thailand port (truck), Thailand port to US port (bulk carrier). Bulk cement off-loading is the responsibility of the receiving customer.

## 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** | Data represents the prevailing technology in use at the two Siam Cement plants in Thailand. Whenever available, for all upstream and core material and processes, both International and North American typical or global average industry LCI datasets were utilized.<br>Both plants utilize *a preheater and precalcinator kiln technology*. *Technological representativeness is characterized as "high".* |
| **Geographic Coverage** | The geographic region considered is Global.<br>*Geographical representativeness is characterized as "high".* |
| **Time Coverage** | Activity (primary) data are representative of 2022 calendar years (12 months).<br>- combined plant limestone quarrying<br>- combined plant clinker production,<br>- combined plant Type IL cement manufacturing,<br>- In-bound/out-bound transportation data - cement manufacturing plant and transport to four cement customers on the pacific coast and Hawaii.<br><br>*Temporal representativeness is characterized as "high".* |
| **Completeness** | 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 outbound transport) profile for Type IL cement. The completeness of the foreground process chain in terms of process steps was rigorously assessed. |
| **Consistency** | 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]. |
| **Reproducibility** | External reproducibility is not possible as the source LCI data and subsequent LCA background reports are confidential. |

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| **Transparency** | Activity datasets are disclosed in the project LCI compilation and the background reports generated by the GCCA Tool. |
| **Uncertainty** | A *sensitivity check* 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. |

## Life Cycle Impact Assessment Results: SCG Plants 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 two plants inclusive of transportation to each cement customer port.

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 | **Honolulu Type IL** ASTM C595 | **Oakland Type IL** ASTM C595 | **Sacramento Type IL** ASTM C595 | **Seattle Type IL** ASTM C595 | **Portland Type IL** ASTM C595 |
|---|---|---|---|---|---|---|
| Global warming potential, GWP 100, AR5 | kg CO2 eq | 880 | 896 | 896 | 892 | 893 |
| Ozone depletion potential, ODP | kg CFC-11 eq | 2.75E-05 | 3.07E-05 | 3.08E-05 | 3.00E-05 | 3.01E-05 |
| Smog formation potential, SFP | kg O3 eq | 41.1 | 43.4 | 43.5 | 42.9 | 43.0 |
| Acidification potential, AP | kg SO2 eq | 3.0 | 3.3 | 3.2 | 3.3 | 3.2 |
| Eutrophication potential, EP | kg N eq | 4.2 | 4.3 | 4.3 | 4.2 | 4.2 |
| Abiotic depletion potential for non-fossil, mineral resources ADP elements* | kg Sb eq | 1.48E-04 | 1.52E-04 | 1.51E-04 | 1.52E-04 | 1.51E-04 |
| Abiotic depletion potential for fossil resources, ADP fossil* | MJ LHV | 5606 | 5821 | 5829 | 5777 | 5782 |

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|---|---|---|---|---|---|---|
| Renewable primary resources used as an energy carrier (fuel), RPRE* | MJ LHV | 1271 | 1277 | 1277 | 1276 | 1276 |
| Renewable primary resources with energy content used as material, RPRM* | MJ LHV | 0 | 0 | 0 | 0 | 0 |
| Non-renewable primary resources used as an energy carrier (fuel), NRPRE* | MJ LHV | 5606 | 5821 | 5777 | 5829 | 5782 |
| Non-renewable primary resources with energy content used as material, NRPRM* | MJ LHV | 0 | 0 | 0 | 0 | 0 |
| Secondary materials, SM* | kg | 1042 | 1042 | 1042 | 1042 | 1042 |
| Renewable secondary fuels, RSF * | MJ LHV | 112 | 112 | 112 | 112 | 112 |
| Non-renewable secondary fuels, NRSF * | MJ LHV | 131 | 131 | 131 | 131 | 131 |
| Recovered energy, RE* | MJ LHV | 0 | 0 | 0 | 0 | 0 |
| Consumption of freshwater, FW* | m3 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| Hazardous waste disposed, HWD* | kg | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Non-hazardous waste disposed, NHWD * | kg | 0.58 | 0.58 | 0.58 | 0.58 | 0.58 |
| High-level radioactive waste, conditioned, to final repository, HLRW* | kg | 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]) |
| Components for re-use, CRU* | kg | 0 | 0 | 0 | 0 | 0 |
| Materials for recycling, MFR* | kg | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Materials for energy recovery, MER* | kg | 0 | 0 | 0 | 0 | 0 |
| Recovered energy exported from the product system, EE* | MJ LHV | 0 | 0 | 0 | 0 | 0 |
| ***Additional Indicators*** | | | | | | |
| Global warming potential - biogenic, GWPbio* | kg $CO_2$ eq | 0.5 | 0.6 | 0.6 | 0.5 | 0.6 |

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| Emissions from calcination* | kg $CO_2$ eq | 452 | 452 | 452 | 452 | 452 |
| Emissions from combustion of waste from renewable sources* | kg $CO_2$ eq | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Emissions from combustion of waste from non-renewable sources* | kg $CO_2$ eq | 13 | 13 | 13 | 13 | 13 |

Table Notes:
x[1)] – 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 contributes about 75 to 90 kg $CO_2$e to the overall GWP profile of the imported cements.

## Additional Environmental Information

Both plants are Green Industry Level 5 Certified by the Dept. of Industrial Works. In addition, both plants are:
- ISO 9001:2015 Quality Management System (QMS)
- ISO 14001:2015 Environmental Management System (EMS)
- ISO 45001:2018 Occupational Health and Safety Management System (OHSMS)

## 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. NSF International, Product Category Rule Environmental Product Declarations, PCR for Concrete, V2.1, August 2021.
11. ASTM C150 / C150M – 20 Standard Specification for Portland Cement.
12. API 10a – Specification for Cements and Materials for Well Cementing
13. ASTM C595 / C595M - 21 Standard Specification for Blended Hydraulic Cements
14. AASHTO M 85-21 Standard Specification for Portland Cement (ASTM Designation: C150/C150M-21) https://www.cement-co2-protocol.org/en/
15. WBCSD CSI 2013: $CO_2$ and Energy Protocol Version 3.1 of 9 December 2013. https://www.cement-co2-protocol.org/en/
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