CONEWAGO
MANUFACTURING, LLC

Conewago Precast Concrete Environmental Product Declaration

According to ISO 14025:2006 and ISO 21930:2017

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ASTM International Certified Environmental Product Declaration

This is a product specific business-to-business Type III environmental product declaration (EPD) for structural precast concrete as produced by Conewago Manufacturing, LLC. This declaration has been prepared in accordance with ISO 14025:2006 [7], ISO 21930:2017 [5], the governing precast concrete category rules [6] and ASTM International's EPD program operator rules.

Environmental Product Declaration Summary

EPD Owner	
CONEWAGO MANUFACTURING, LLC	**Conewago Manufacturing, LLC** 576 Edgegrove Road, Hanover, Pennsylvania USA 17331 Link (URL): https://www.conewagomfg.com/
Product Group and Name	Structural Precast Concrete (UN CPC 37550)
Product Definition	Structural precast concrete is a construction product produced by casting concrete in a reusable mold or "form" which is then cured in a controlled environment, transported to the construction site, and lifted into place. Structural precast concrete is used in building or civil engineering works and is primarily composed of cement, aggregates, and reinforcement materials.
Product Category Rules	NSF PCR for Precast Concrete, V3.0, May 2021. [6].
Certification Period	February 3, 2024 to February 3, 2029
Declared Unit	1 metric tonne (1,000 kg) of structural precast product
ASTM Declaration Number	EPD #627
EPD Program Operator	ASTM International
Declaration Holder	Conewago Manufacturing, LLC

Declaration Type

A product specific EPD for structural precast as a product group manufactured by Conewago Manufacturing, LLC. Activity stages or information modules covered include production with the product ready for shipment from the point of manufacture (modules A1 to A3). The declaration is intended for use in Business-to-Business (B-to-B) communication.

Product Applicability

Structural precast concrete products satisfy a wide array of building and civil engineering applications.

Content of the Declaration

This declaration follows Section 9; Content of an EPD, NSF PCR for Precast Concrete, V3.0, May 2021 [6]

This EPD was independently verified by ASTM in accordance with ISO 14025: ASTM INTERNATIONAL **Internal** **External** **X**	Timothy Brooke ASTM International 100 Barr Harbor Dr. West Conshohocken, PA 19428 tbrooke@astm.org

EPD Project Report Information

EPD Project Report	Cradle-to-Gate Life Cycle Assessment of Conewago's Structural Precast Concrete, December 2023
Prepared by: Athena Sustainable Materials Institute	Mr. Kevin Garrahan and Mr. Jamie Meil Athena Sustainable Materials Institute 119 Ross Avenue, Suite 100 Ottawa, Ontario, Canada K1Y 0N6 info@athenasmi.org
This EPD project report was independently verified by in accordance with ISO 14025 and the reference PCR:	Timothy Brooke ASTM International 100 Barr Harbor Dr. West Conshohocken, PA 19428 tbrooke@astm.org

This EPD was prepared using the GCCA Industry EPD Tool for Clinker, Cement, Aggregates, Concrete and Precast Products V4.1 (October 2023) [1].

PCR Information	
Program Operator	NSF International
Reference PCR	Product Category Rules for Preparing an Environmental Product Declaration for Precast Concrete, V3.0, May 2021 [6].
PCR review was conducted by:	Dr. Thomas Gloria, Industrial Ecology Consultants Mr. Bill Stough, Bill Stough, LCC Dr. Michael Overcash, Environmental Clarity

1. Product Identification

1.1 Product Definition

Precast concrete (UN CPC 37550) is a construction product produced by casting concrete in a reusable mold or "form" which is then cured in a controlled environment, transported to the construction site, and lifted into place. In contrast, cast-in-place concrete is placed into site-specific forms and cured on site. Precast concrete is primarily composed of portland cement, aggregates, and steel reinforcement materials.

For the purposes of this EPD the following broad descriptive definition for structural precast is as follows:

Structural precast products: Superstructure bridge products such as bridge decks, girders, and parapets; substructure bridge products such as abutments, piers, footings, and pile caps; building products such as columns, beams, interior solid bearing and shear walls, double tees, hollow core, spandrels, and solid slabs; stairs and stadia seating; and other items such as piles, footings, barriers, retaining walls, rail ties, sound walls and the like. Structural precast products can be conventionally reinforced or prestressed.

2. Product Application

Structural precast concrete products are engineered products satisfying a wide array of building and civil engineering applications.

3. Declared Unit

The declared unit is one metric tonne of structural precast concrete.

4. Material Content

Table 1 below presents the percent composition of Conewago's structural precast concrete products by input material as derived from facility LCI data for the reference year 2022.

Table 1: Material content for Conewago structural precast concrete (in %)

Inputs	Structural Precast Concrete
Coarse Aggregates	38.6%
Sand	32.4%
Portland Cement	17.9%
Water	7.2%
Reinforcing Steel and Anchors	3.7%
Extruded Polystyrene	>1%
Chemical Admixtures	>1%
Other	>1%
Total	100%

5. Product Stage

Figure 1 shows the Product Stage system boundary for the declared product system.

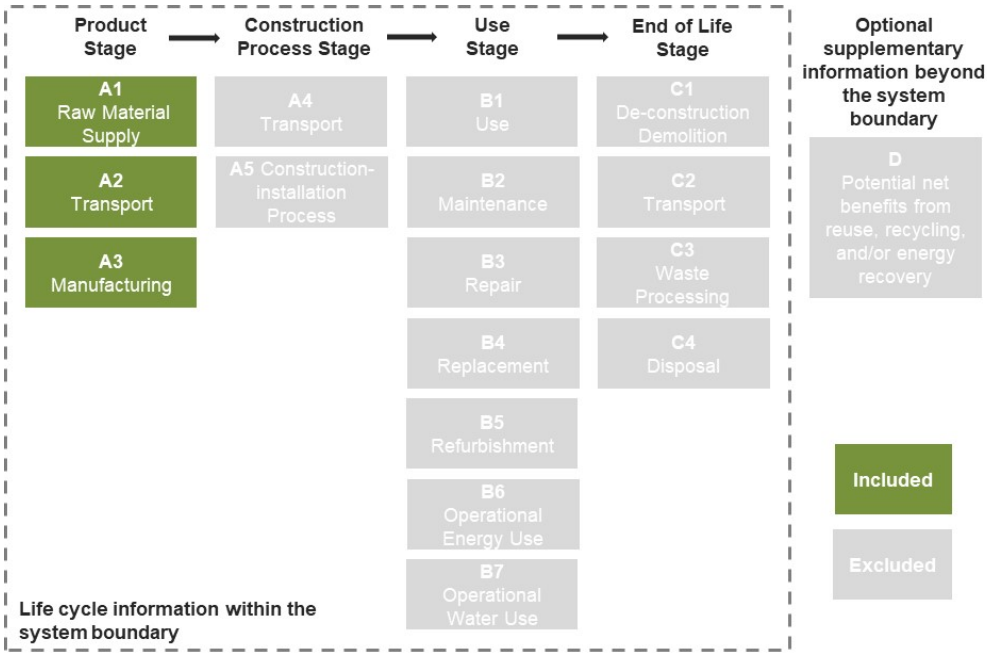

Figure 1: Common life cycle stages and their information modules for construction projects [6].

The Product Stage includes the following processes [6]:

- A1 shall include the constituents of concrete listed in NSF PCR Part A Table 1;
- A2 shall assume all long-haul transport by bulk carriers (greater than 322 km (200 mi)). Long-haul trucks do not typically return empty and thus can use the US LCI dataset which includes 35% additional distance to account for this;
- A2 shall assume that all short haul transport (local trucks and dump trucks) return empty. Thus, one way transport distance less than 322 km (200 mi) shall be multiplied by (2/1.35) to reflect two-way transport and eliminate the 35% additional distance included in the US LCI. This calculation is automatically applied to short haul transportation distances by the GCCA Tool;
- A3 shall include transportation activities at the concrete manufacturing site;
- A3 shall include ancillary materials which include, but are not limited to, lubricating oils, engine oils, & other consumable operations equipment maintenance (OEM) products;
- A3 shall include final end of life treatment for any manufacturing waste. For example, admixture and ancillary material packaging.

The Product Stage excludes the following processes [6]:

- Production, manufacture, and construction of manufacturing capital goods and infrastructure;
- Formwork;
- Production and manufacture of production equipment, delivery vehicles, and laboratory equipment;
- Personnel related activities (travel, office operations and 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.

6. Life Cycle Inventory

6.1 Data Collection and Representativeness

Life cycle inventory data was collected from Conewago Manufacturing, LLC for the 2022 reference year. In addition, this EPD draws on company specific EPDs within Conewago's supply chain for reinforcing steel and extruded polystyrene insulation [12], [13].

6.2 Cut Off Rules, Allocation Rules, and Data Quality Requirements

6.2.1 Cut-Off Rules

Cut-off rules, as specified in NSF PCR for precast concrete: 2021, Section 7.1.8 were applied [6]. All input/output flow data reported by the participating member facilities were included in the LCI modeling. None of the reported flow data were excluded based on the cut-off criteria.

6.2.2 Allocation Rules

Allocation procedures observed the requirements and guidance of ISO 14044:2006, clause 4.3 and those specified in NSF PCR for precast concrete, section 7.1. Conewago produced both structural precast concrete, and architectural insulated precast concrete – a co-product – during the 2022 reference year. As such, allocation was required between co-products.

Product-specific material inputs related to structural precast concrete were collected from the manufacturer to eliminate the need for allocation of material inputs between the structural and architectural insulated precast concrete products. Material inputs for structural precast concrete were normalized against the total production of structural precast concrete during the reference year to provide reference flows per *metric tonne of structural precast concrete production*. Material inputs for architectural precast concrete were not incorporated in the scope of this study.

Data for energy use (such as electricity usage, gasoline, diesel, etc.) and waste from manufacturing, were not provided separately for architectural insulated and structural precast concrete products. Energy and waste flows were allocated by "mass" and normalized against the total production (including structural and architectural insulated precast concrete) to provide reference energy and waste flows per *metric tonne of total production*.

In addition, the following allocation rules are applied:

- Allocation related to transport is based on the mass and distance of transported inputs;
- The NSF sub-category PCR recognizes fly ash, silica fume and granulated bast furnace 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 precast concrete material input. That is, any allocations before reprocessing are allocated to the original product;
- The environmental flows related to the disposal of the manufacturing (pre-consumer) solid and liquid waste are allocated to module A3 Manufacturing.

6.2.3 Data Quality Requirements

As specified in NSF PCR, Section 7.1.9 [6], and ISO 21930, 7.1.9 [5], appropriate activity and LCI foreground and background data shall be used to model the precast concrete product systems. LCI data should be as representative (technologically, geographically, and time-specific), complete, consistent, reproducible and transparent as possible with regards to the goal and scope of the study [3], [4].

Primary LCI and meta-data for Conewago's structural precast concrete production was gathered for the 2022 reference year. For accuracy, the LCA team individually validated these gate-to-gate input and output data.

Since the GCCA Industry EPD Tool is pre-verified to meet the requirements of ISO 21930:2017 and the NSF PCR [6], the need to assess the background data was limited to upstream product-specific EPDs and background data for rebar and extruded polystyrene insulation, both of which are characterized as *high* representativeness for Technological, Geographical, and Time coverage.

Completeness: All relevant, specific processes, including inputs (raw materials, energy and ancillary materials) and outputs (emissions and production volume) were considered and modeled to complete production profile for Conewago's plant producing the structural precast concrete.

Reproducibility: Internal reproducibility is possible since the data and the model is stored and available in Athena's GCCA Tool database. The provision of more detailed data to allow for full external reproducibility is not possible due to reasons of confidentiality.

Transparency: Activity and LCI datasets are transparently disclosed in this project report, including data sources (see Annexes A and D of the EPD Project Report).

7. Life Cycle Assessment

7.1 Results of the Life Cycle Assessment

This section summarizes the results of the life cycle impact assessment (LCIA) based on the cradle-to-gate life cycle inventory inputs and outputs analysis. The results are calculated on the basis of one metric tonne (1,000 kg) of structural precast (Table 2). The structural precast production results are delineated by information module (A1 – Raw material supply), (A2 – Raw material transport), and (A3 – precast concrete manufacturing).

As per NSF PCR Section 7.3 [6], the US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), version 2.1, 2012 impact categories are used as they provide a North American context for the mandatory category indicators to be included in this EPD. These are relative expressions only and do not predict category impact end-points, the exceeding of thresholds, safety margins or risks. Total primary and sub-set energy consumption was compiled using a cumulative energy demand model. Material resource consumption and generated waste reflect cumulative life cycle inventory flow information.

In addition, some LCA impact categories and inventory items are still under development and can have high levels of uncertainty. These impact categories and inventory items are marked with an asterisk “*”.

Table 2: LCA results – Per Metric Tonne of Structural Precast Concrete - Conewago

Impact category and inventory indicators	Unit	Module A1	Module A2	Module A3	Total
Environmental impacts					
Global warming potential	kg CO_2 eq.	201	16.2	3.46	**220.7**
Global warming potential, biogenic	kg CO_2 eq.	1.79E-2	5.00E-3	2.05E-2	**4.34E-2**
Ozone depletion potential	kg CFC-11	4.10E-6	1.69E-6	4.51E-7	**6.24E-6**
Eutrophication potential	kg N eq.	0.2816	2.028E-2	2.609E-2	**0.33**
Acidification potential	kg SO_2 eq.	0.4044	0.1160	1.421E-2	**0.53**
Photochemical oxidant creation potential	kg O_3 eq.	8.623	2.597	8.599E-2	**11.31**
Use of primary resources					
Renewable primary resources used as an energy carrier (fuel)*	MJ, LHV	61.49	2.570	1.273	**65.33**
Renewable primary resources with energy content used as material*	MJ, LHV	0	0	0	**0**
Total use of renewable primary energy resources*	MJ, LHV	61.49	2.570	1.273	**65.33**
Non-renewable primary resources used as an energy carrier (fuel)*	MJ, LHV	1434	229.5	59.71	**1723**
Non-renewable primary resources with energy content used as material*	MJ, LHV	1.475	0	0	**1.475**
Total use of non-renewable primary energy resources*	MJ, LHV	1435	229.5	59.71	**1724**
Use of secondary resources					
Secondary materials*	kg	68.54	0	0	**68.54**
Renewable secondary fuels*	MJ, LHV	0	0	0	**0**
Non-renewable secondary fuels*	MJ, LHV	0	0	0	**0**
Abiotic depletion potential					
Abiotic depletion potential for non-fossil mineral resources*	ADPe	1.051E-4	8.542E-5	3.096E-6	**1.936E-4**
Abiotic depletion potential for fossil resources*	ADPf	944.9	229.5	59.71	**1234**
Consumption of freshwater resources					
Consumption of freshwater*	m^3	1.560	3.280E-2	8.963E-2	**1.682**
Waste and output flows					
Hazardous waste disposed*	kg	4.853E-3	0	0	**4.853E-3**
Non-hazardous waste disposed*	kg	6.534E-2	0	1.165	**1.231**
Components for reuse*	kg	0	0	0	**0**
Materials for recycling*	kg	67.66	0	1.055	**68.71**
Materials for energy recovery*	kg	4.566E-3	0	0	**4.566E-3**
Recovered energy exported from the product system*	MJ per energy	0	0	0	**0**
Additional inventory parameters for transparency					
Emissions from calcination and removals from carbonation*	kg CO2 eq.	86.85	0	0	**86.85**

7.2 Interpretation

The Extraction and Upstream Production (A1) Module is the main contributor to the potential environmental impacts. The potential environmental impacts associated with Module A1 are predominantly driven by the production of cement and reinforcing steel.

The Raw Material Transportation (A2) Module is the second largest contributor, primarily due to the transportation of high mass materials, such as aggregates, rebar, and cement.

8. Declaration Type

The type of EPD is defined as:

A “cradle-to-gate” EPD for structural precast concrete manufactured by Conewago Manufacturing’s facility. Activity stages, or information modules, covered include raw material extraction, transport of raw materials to manufacturing facility, and production with the product ready for shipment at the manufacturing plant (modules A1 to A3). The declaration is intended for use in Business-to-Business (B-to-B) communication.

9. Declaration Comparability Limitation Statement

Environmental declarations from different programs (ISO 14025) may not be comparable. EPDs are comparable only if they use the same PCR (or sub-category PCR where applicable), include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works. This PCR allows EPD comparability only when the same functional requirements between products are ensured and the requirements of ISO 21930:2017 §5.5 are met. However, variations and deviations are possible. Example of variations: different LCA software and background LCI datasets may lead to different results for the life cycle stages declared.

10. EPD Explanatory Material

For any explanatory material, in regard to this EPD, please contact the program operator.

ASTM International
Environmental Product Declarations
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References

[1] Global Cement and Concrete Association (GCCA) and Portland Cement Association (PCA), GCCA Industry EPD Tool for Cement and Concrete (V4.1), User's Manual, North American version, Prepared by Quantis, October 2023. https://concrete-epd-tool.org/

[2] Global Cement and Concrete Association (GCCA) LCA Database, North American version (V4.1) Prepared by Quantis, October 2023.

[3] ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework.

[4] ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines.

[5] ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.

[6] NSF International, Product Category Rule for Environmental Product Declarations, PCR for Precast Concrete, V3.0, May 2021

[7] ISO 14025:2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.

[8] ISO 14021:2016 Environmental labels and declarations -- Self-declared environmental claims (Type II environmental labelling).

[9] ISO 14048:2002. Environmental management — Life cycle assessment — Data documentation format.

[10] ACLCA 2019, Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017. The American Centre for Life Cycle Assessment. May, 2019.
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[11] U.S. Environmental Protection Agency (2012). Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) TRACI version 2.1.
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[12] Re-Steel Supply Co, Inc. Environmental Product Declaration – Fabricated Carbon-Steel and Low-Alloy Uncoated Reinforcing Bar, ASTM International, June 24, 2021. https://pcr-epd.s3.us-east-2.amazonaws.com/700.Epd_for_Re-Steel_Final2.pdf

[13] Owens Corning, Environmental Product Declaration – Foamular NGX XPS Insulation, UL Environment, January 1, 2021. https://spot.ul.com/main-app/products/detail/5fda3d2f55b0e8304421fbf1?page_type=Products%20Catalog