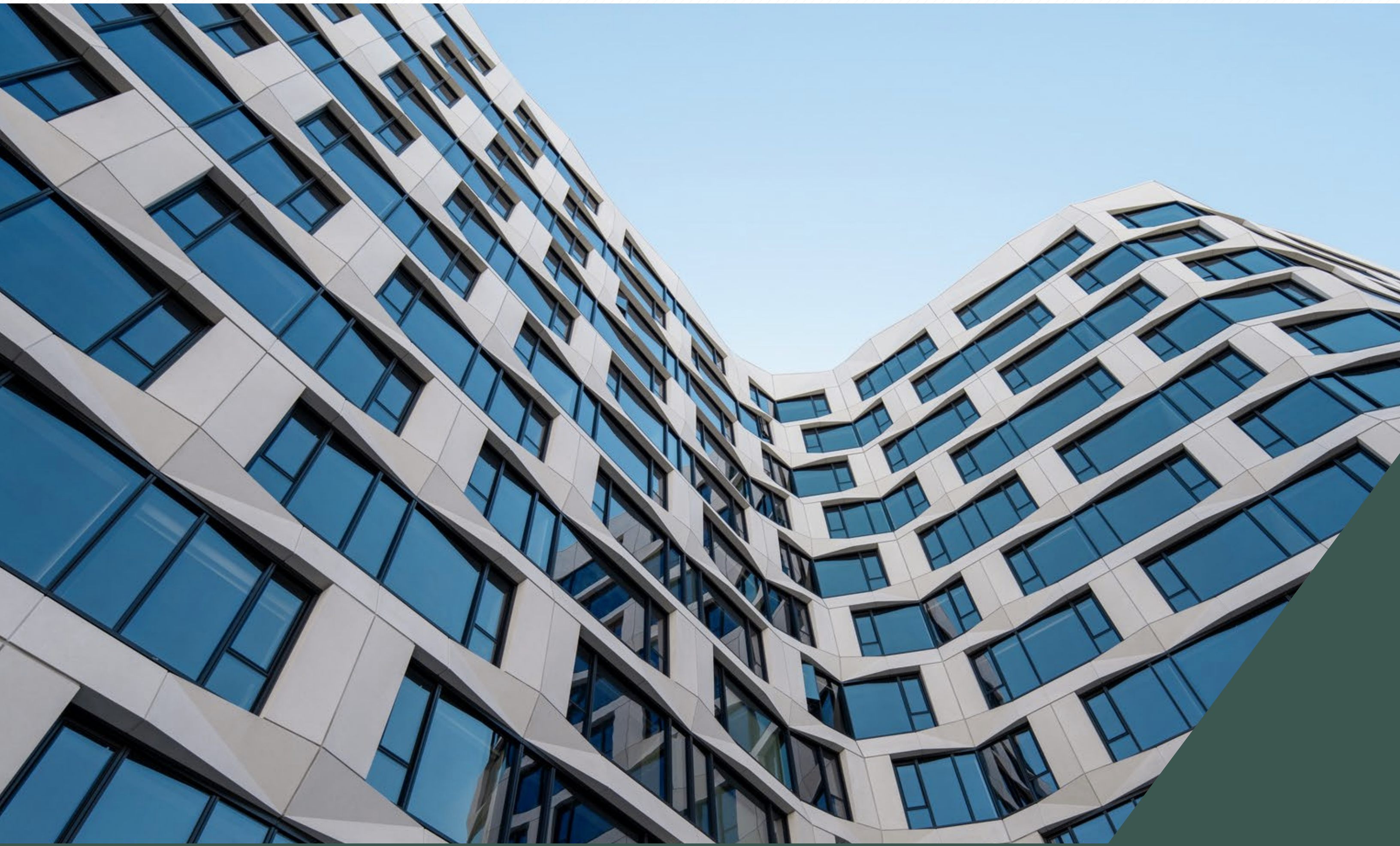
# ARCHITECTURAL PRECAST CONCRETE

## REGIONALIZED INDUSTRY AVERAGE EPD

*According to ISO 14025:2006 and ISO 21930:2017*



ASTM INTERNATIONAL

100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. United States.

## ASTM International Certified Environmental Product Declaration

This is a business-to-business Type III environmental product declaration for Architectural Precast as produced by PCI. This declaration has been prepared in accordance with ISO 14025:2006 and ISO 21930:2017, the governing precast concrete category rules and ASTM international's EPD program operator rules.

The intent of this document is to further the development of environmentally compatible and more sustainable construction products by providing comprehensive environmental information related to potential impacts of architectural precast concrete in accordance with international standards.

## Environmental Product Declaration Summary

| **EPD Owner** | |
|---|---|
| PCI Precast/Prestressed Concrete Institute | **Precast/Prestressed Concrete Institute**<br>8770 W Bryn Mawr Ave Suite 1150,<br>Chicago, IL 60631, United States<br>www.pci.org |
| **Product Group and Name** | Architectural Precast concrete products |
| **Product Definition** | **Architectural Precast Concrete (UN CPC 3755)** is a construction material created by casting concrete into reusable molds and curing it in a controlled setting. It serves both structural and aesthetic functions, enhancing building designs with various finishes such as acid etching, sand blasting, and staining. |
| **Product Category Rules** | NSF/ASTM International, PCR for Precast Concrete, V3.0, May 2021. |
| **Certification Period** | 05.01.2025 - 05.01.2030 |
| **Declared Unit** | 1 metric tonne (1,000 kg) of architectural precast concrete |
| **ASTM Declaration Number** | EPD 962 |

| | |
|---|---|
| **EPD Program Operator** | ASTM International |
| **Declaration Holder** | Precast/Prestressed Concrete Institute |
| **Declaration Type**<br>A "cradle-to-gate" EPD for architectural precast concrete as a product group manufactured by 64 PCI member facilities spread across 11 regions in the United States. Activity stages or information modules covered include all 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**<br>**Architectural precast concrete** includes cladding panels, decorative trims, façade elements, columns, beams, and other components designed to enhance the aesthetic and structural integrity of buildings. | |
| **Content of the Declaration** This declaration follows Section 9; Content of an EPD, NSF/ASTM International PCR for Precast Concrete, V3.0, May 2021. | |
| **This EPD was independently verified by ASTM in accordance with ISO 14025:**<br>**Internal** **External**<br>X (External) | Timothy Brooke<br>ASTM International<br>100 Barr Harbor Dr.<br>West Conshohocken, PA 19428<br>tbrooke@astm.org |
| **EPD Project Report Information** | |
| **EPD Project Report** | A Cradle-to-Gate LCA of Architectural Precast Concrete Products produced by PCI members, March 2025 |
| **Prepared by** | **WAP Sustainability Consulting LTD**<br>1701 Market Street<br>Chattanooga, TN 37408<br>https://wapsustainability.com/ |
| **This EPD project report was independently verified by in accordance with ISO 14025 and the reference PCR:** | Thomas P. Gloria, Ph. D.<br>Industrial Ecology Consultants<br>35 Bracebridge Rd.<br>Newton, MA 02459-1728<br>t.gloria@industrial-ecology.com |
| This EPD was prepared using WAP's Theta Concrete EPD Tool v1 | |
| **PCR Information** | |
| **Program Operator** | NSF and ASTM International |
| **Reference PCR** | NSF/ASTM International, PCR for Precast Concrete, V3.0, May 2021. |
| **PCR review was conducted by:** | Dr. Thomas Gloria, Industrial Ecology Consultants<br>Mr. Bill Stough, Bill Stough, LCC<br>Dr. Michael Overcash, Environmental Clarity |

# 1 PRODUCT IDENTIFICATION

### 1.1 PRODUCT DEFINITION

Precast concrete (UN CPC 3755) 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, standard concrete is placed into site-specific forms and cured on site. In order of greatest mass, the products covered in this EPD are composed of Aggregates, Portland Cement, Portland Limestone cement, Batch water, fly ash, Rebar, Welded wire reinforcement, Steel and including other Admixtures/ SCMs.

Architectural precast products can be conventionally reinforced or prestressed. It typically uses steel reinforcement elements such as rebar and welded wire mesh. These materials enhance the concrete's tensile strength and help resist cracking. This product focuses on both aesthetic appeal and structural integrity, providing durable and visually appealing components for various architectural applications.

# 2 PRODUCT APPLICATION

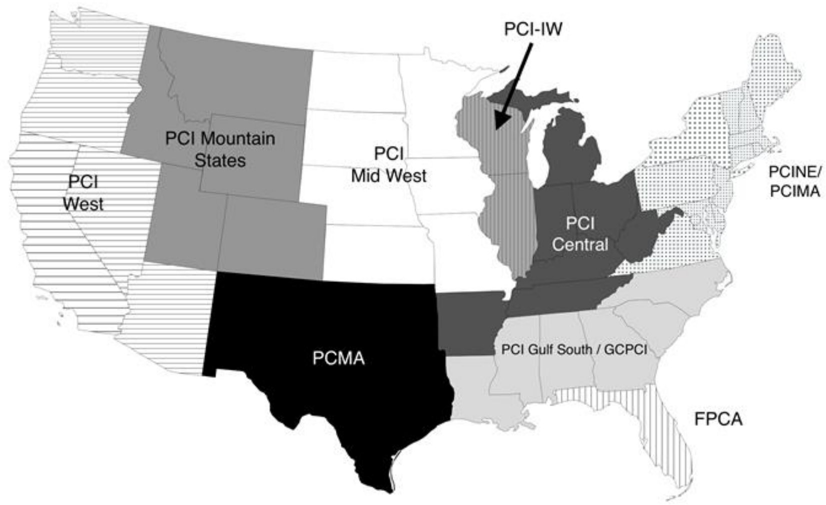
Architectural precast concrete enhances both the aesthetics and structure of buildings. It includes cladding panels, decorative trims, façade elements, columns, beams, and slabs. Cladding panels provide insulation and a stylish finish. Façade elements add intricate designs to exteriors. Columns and beams offer structural support with decorative finishes. Balconies and parapets are durable and visually pleasing. Public art installations and monuments benefit from its moldability into complex shapes. Interior uses include feature walls, staircases, and flooring. Architectural precast concrete can be reinforced or prestressed for added strength and durability.

# 3 DECLARED UNIT

The declared unit is 1 metric tonne of architectural precast concrete products.

This study for the architectural precast concrete products considers regional factors for accurate results, covering all 11 PCI regions in the United States as derived from LCI data for the reference year 2023. Two sets of regions were combined to anonymize data, ensuring a comprehensive analysis that reflects specific conditions and highlights supply chain improvement opportunities. The regions assessed in this study are shown in Figure 1.

**Figure 1: PCI Production Regions Considered in this Study.**




# 4 PRODUCTION STAGE

**Figure 2 Production stage system boundary**

| Production | | | Construction | | Use | | | | | | | End of Life | | | | Benefits & Loads Beyond System Boundary |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| Raw Material Supply | Transport | Manufacturing | Transport to Site | Assembly/Install | Use | Maintenance | Repair | Replacement | Refurbishment | Operational Energy Use | Operational Water Use | Deconstruction | Transport | Waste Processing | Disposal | Reuse, Recovery, Recycling Potential |
| X | X | X | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND |

X = Module Included in LCA Report, MND = Module not Declared

Figure 2 shows the production stage system boundary for the declared product system.
The Production Stage includes the following processes:

- A1 - Extraction and processing of raw materials, including fuels used in product production and transport within the manufacturing process (A3);
- A2 - Average or specific transportation of raw materials from the extraction site or source to manufacturing site, inclusive of empty backhauls (where applicable);
- A3 - Manufacturing of each precast product including all energy and materials required and all emissions and wastes produced;
- Average or specific transportation from manufacturing site to recycling/reuse/landfill for pre-consumer wastes and unutilized by-products from manufacturing, including empty backhauls (where applicable); and
- Final disposition of pre-consumer wastes inclusive of transportation.

The Production Stage excludes the following processes:

- 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.

# 5 LIFE CYCLE INVENTORY

## 5.1 DATA COLLECTION AND REPRESENTATIVENESS

All gate-to-gate LCI flow data for energy, total water use, emissions and waste generated were used to determine an overall per unit precast plant operations profile. These per unit gate-to-gate operational flows were used to calculate the plant production effects for Architectural Precast Concrete. Each plant also provided material consumption data that was specific to Architectural Precast production which was used to develop an average composition on a production weighted basis.

## 5.2 CUT OFF RULES, ALLOCATION RULES AND DATA QUALITY REQUIREMENTS

*Cut-off rules*, as specified in NSF PCR for precast concrete: 2021, Section 7.1.8 were applied. 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. 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.
*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. A small number of the facilities also produced other specialty precast products – a co-product - and in such instances “mass” allocation was used to allocate facility LCI environmental flows (inputs and outputs) across the co-products for

those facilities prior to calculating and rolling up the weighted average LCI flows for the gate-to-gate process and individual product groups.

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.

**Data quality requirements**, as specified in NSF's Precast Concrete PCR: 2021, section 7.1.9, were observed. This section also describes the achieved data quality relative to the ISO 14044:2006 requirements. Data quality is judged on the basis of its precision (measured, calculated or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied within a study serving as a data source) and representativeness (geographical, temporal, and technological).

**Precision**: The precision of the data is considered high. The participating member companies through measurement and calculation collected primary data on their production of architectural precast concrete. For accuracy the LCA team individually validated these plant gate-to-gate input and output data.

**Completeness**: All relevant, specific processes, including inputs (raw materials, energy and ancillary materials) and outputs (emissions and production volume) were considered and modeled to represent architectural precast production. The relevant background materials and processes were taken from the US LCI Database, Ecoinvent v 3.4 LCI database for Canada, United States and/or global and modeled in WAP's pre-verified Theta Concrete EPD Tool v2 (February 2022).

**Consistency**: The consistency of the model is considered high. The bills of materials provided by the product engineers were developed for multiple internal departments use and are maintained regularly. The LCA practitioner also cross-referenced the installation documents and other relevant information to ensure consistency. Furthermore, modeling assumptions were consistent across the model, with preference given towards Ecoinvent data, where available.

**Reproducibility**: This study is considered reproducible. Descriptions of the data and assumptions through this report would allow a practitioner to utilize the LCA tool to generate results for the products. A high level of transparency is provided throughout the LCA background report (publicly available) as the weighted average LCI profile for each product sub-group is presented for the declared product. Key primary (manufacturer specific) and secondary (generic) LCI data sources are also summarized in the LCA background report. The provision of more detailed data to allow full external reproducibility was not possible due to reasons of confidentiality.

**Representativeness**: The representativeness of the data is summarized as follows.

- ***Time related coverage*** of the precast manufacturing process - primary data collected: 2023 (12 months).
- Generic data: the most appropriate LCI datasets were used as found in the US LCI (adjusted) Database, Ecoinvent v.3.4 database for United States, Canada and global.
- ***Geographical coverage***: the geographical coverage is the United States.
- ***Technological coverage***: typical or average.

# 6 LIFE CYCLE ASSESSMENT

## 6.1. 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 Architectural Precast Concrete products. The production results are delineated by information module (A1 – Raw material supply), (A2 – Raw material transport), and (A3 – precast core manufacturing).

As per NSF PCR for precast concrete:2021, Section 7.3, 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. To promote uniform guidance on the data collection, calculation and reporting of results, the ISO 21930 was used.

**Table 1: Cradle to Gate Results for One Metric Tonne Architectural Precast Concrete Produced in the FPCA Region**

| Indicator | A1-A3 | A1 | A2 | A3 |
|---|---|---|---|---|
| **Environmental Impacts** | | | | |
| GWP [kg CO2 eq] | 3.39E+02 | 1.96E+02 | 8.89E+01 | 5.36E+01 |
| ODP [kg CFC 11 eq] | 8.56E-06 | 3.93E-06 | 3.73E-09 | 4.62E-06 |
| EP [kg N eq] | 4.69E-01 | 2.12E-01 | 6.38E-02 | 1.94E-01 |
| AP [kg SO2 eq] | 1.69E+00 | 4.28E-01 | 1.07E+00 | 1.97E-01 |
| POCP [kg O3 eq] | 3.90E+01 | 7.67E+00 | 2.75E+01 | 3.80E+00 |
| **Use of Primary Resources** | | | | |
| RPRE [MJ] | 9.94E+01 | 9.11E+01 | 0.00E+00 | 8.35E+00 |
| RPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRPRE [MJ] | 3.60E+03 | 1.37E+03 | 1.34E+03 | 8.80E+02 |
| NRPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Use of Secondary Resources** | | | | |
| SM [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| RSF [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRSF [MJ] | 8.08E+01 | 8.08E+01 | 0.00E+00 | 0.00E+00 |
| RE [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Abiotic Depletion Potential** | | | | |
| ADPF [MJ] | 2.99E+03 | 1.00E+03 | 1.27E+03 | 7.15E+02 |
| ADPE [kg Sb eq] | 1.79E-04 | 1.44E-04 | 0.00E+00 | 3.56E-05 |
| **Consumption of Freshwater** | | | | |
| FW [m3] | 2.65E+00 | 1.17E+00 | 0.00E+00 | 1.48E+00 |
| **Waste and Output Flows** | | | | |
| HWD [kg] | 1.23E-01 | 5.08E-02 | 0.00E+00 | 7.19E-02 |
| NHWD [kg] | 3.57E+01 | 1.92E+00 | 0.00E+00 | 3.38E+01 |
| HLRW [m3] | 1.83E-03 | 1.83E-03 | 0.00E+00 | 5.46E-08 |
| ILLRW [m3[ | 5.38E-04 | 5.38E-04 | 0.00E+00 | 5.27E-07 |
| CRU [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MR [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MER [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EE [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Additional inventory parameters for transparency** | | | | |
| CCE [kg CO2 eq] | 7.42E+01 | 7.42E+01 | 0.00E+00 | 0.00E+00 |

## Table 2: Cradle to Gate Results for One Metric Tonne Architectural Precast Concrete Produced in the GCPCI and PCI Gulf South Region

| Indicator | A1-A3 | A1 | A2 | A3 |
|---|---|---|---|---|
| **Environmental Impacts** | | | | |
| GWP [kg CO2 eq] | 3.35E+02 | 2.28E+02 | 5.05E+01 | 5.63E+01 |
| ODP [kg CFC 11 eq] | 8.36E-06 | 4.60E-06 | 2.09E-09 | 3.76E-06 |
| EP [kg N eq] | 6.25E-01 | 2.55E-01 | 3.92E-02 | 3.31E-01 |
| AP [kg SO2 eq] | 1.68E+00 | 7.95E-01 | 6.73E-01 | 2.12E-01 |
| POCP [kg O3 eq] | 2.91E+01 | 8.71E+00 | 1.78E+01 | 2.58E+00 |
| **Use of Primary Resources** | | | | |
| RPRE [MJ] | 1.06E+02 | 9.14E+01 | 0.00E+00 | 1.50E+01 |
| RPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRPRE [MJ] | 3.20E+03 | 1.53E+03 | 7.52E+02 | 9.22E+02 |
| NRPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Use of Secondary Resources** | | | | |
| SM [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| RSF [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRSF [MJ] | 9.83E+01 | 9.83E+01 | 0.00E+00 | 0.00E+00 |
| RE [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Abiotic Depletion Potential** | | | | |
| ADPF [MJ] | 2.53E+03 | 1.15E+03 | 7.10E+02 | 6.65E+02 |
| ADPE [kg Sb eq] | 3.24E-04 | 2.92E-04 | 0.00E+00 | 3.22E-05 |
| **Consumption of Freshwater** | | | | |
| FW [m3] | 2.32E+00 | 1.10E+00 | 0.00E+00 | 1.22E+00 |
| **Waste and Output Flows** | | | | |
| HWD [kg] | 4.52E-02 | 4.52E-02 | 0.00E+00 | 0.00E+00 |
| NHWD [kg] | 3.47E+01 | 5.65E+00 | 0.00E+00 | 2.90E+01 |
| HLRW [m3] | 1.75E-03 | 1.75E-03 | 0.00E+00 | 1.06E-07 |
| ILLRW [m3[ | 4.73E-04 | 4.72E-04 | 0.00E+00 | 9.83E-07 |
| CRU [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MR [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MER [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EE [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Additional inventory parameters for transparency** | | | | |
| CCE [kg CO2 eq] | 9.02E+01 | 9.02E+01 | 0.00E+00 | 0.00E+00 |

## Table 3: Cradle to Gate Results for One Metric Tonne Architectural Precast Concrete Produced in the PCI Central Region

| Indicator | A1-A3 | A1 | A2 | A3 |
|---|---|---|---|---|
| **Environmental Impacts** | | | | |
| GWP [kg CO2 eq] | 3.54E+02 | 2.09E+02 | 7.32E+01 | 7.15E+01 |
| ODP [kg CFC 11 eq] | 8.42E-06 | 4.43E-06 | 3.09E-09 | 3.98E-06 |
| EP [kg N eq] | 6.62E-01 | 2.44E-01 | 5.14E-02 | 3.66E-01 |
| AP [kg SO2 eq] | 1.68E+00 | 4.87E-01 | 8.60E-01 | 3.30E-01 |
| POCP [kg O3 eq] | 3.22E+01 | 8.10E+00 | 2.18E+01 | 2.24E+00 |
| **Use of Primary Resources** | | | | |
| RPRE [MJ] | 1.01E+02 | 8.49E+01 | 0.00E+00 | 1.59E+01 |
| RPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRPRE [MJ] | 3.70E+03 | 1.38E+03 | 1.11E+03 | 1.21E+03 |
| NRPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Use of Secondary Resources** | | | | |
| SM [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| RSF [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRSF [MJ] | 9.23E+01 | 9.23E+01 | 0.00E+00 | 0.00E+00 |
| RE [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Abiotic Depletion Potential** | | | | |
| ADPF [MJ] | 2.96E+03 | 1.01E+03 | 1.05E+03 | 9.00E+02 |
| ADPE [kg Sb eq] | 1.88E-04 | 1.54E-04 | 0.00E+00 | 3.40E-05 |
| **Consumption of Freshwater** | | | | |
| FW [m3] | 1.98E+00 | 1.08E+00 | 0.00E+00 | 8.99E-01 |
| **Waste and Output Flows** | | | | |
| HWD [kg] | 4.55E-02 | 4.55E-02 | 0.00E+00 | 0.00E+00 |
| NHWD [kg] | 2.99E+01 | 4.70E+00 | 0.00E+00 | 2.52E+01 |
| HLRW [m3] | 1.76E-03 | 1.76E-03 | 0.00E+00 | 1.17E-07 |
| ILLRW [m3[ | 4.77E-04 | 4.76E-04 | 0.00E+00 | 1.09E-06 |
| CRU [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MR [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MER [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EE [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Additional inventory parameters for transparency** | | | | |
| CCE [kg CO2 eq] | 8.47E+01 | 8.47E+01 | 0.00E+00 | 0.00E+00 |

## Table 4: Cradle to Gate Results for One Metric Tonne Architectural Precast Concrete Produced in the PCI-IW

| Indicator | A1-A3 | A1 | A2 | A3 |
|---|---|---|---|---|
| **Environmental Impacts** | | | | |
| GWP [kg CO2 eq] | 2.68E+02 | 2.11E+02 | 2.27E+01 | 3.42E+01 |
| ODP [kg CFC 11 eq] | 5.71E-06 | 4.42E-06 | 9.52E-10 | 1.28E-06 |
| EP [kg N eq] | 3.53E-01 | 2.44E-01 | 1.64E-02 | 9.20E-02 |
| AP [kg SO2 eq] | 9.87E-01 | 5.01E-01 | 2.78E-01 | 2.09E-01 |
| POCP [kg O3 eq] | 1.67E+01 | 8.16E+00 | 7.13E+00 | 1.38E+00 |
| **Use of Primary Resources** | | | | |
| RPRE [MJ] | 9.13E+01 | 8.62E+01 | 0.00E+00 | 5.13E+00 |
| RPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRPRE [MJ] | 2.32E+03 | 1.39E+03 | 3.43E+02 | 5.88E+02 |
| NRPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Use of Secondary Resources** | | | | |
| SM [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| RSF [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRSF [MJ] | 9.26E+01 | 9.26E+01 | 0.00E+00 | 0.00E+00 |
| RE [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Abiotic Depletion Potential** | | | | |
| ADPF [MJ] | 1.83E+03 | 1.02E+03 | 3.23E+02 | 4.88E+02 |
| ADPE [kg Sb eq] | 1.70E-04 | 1.58E-04 | 0.00E+00 | 1.14E-05 |
| **Consumption of Freshwater** | | | | |
| FW [m3] | 2.14E+00 | 1.09E+00 | 0.00E+00 | 1.05E+00 |
| **Waste and Output Flows** | | | | |
| HWD [kg] | 4.67E-02 | 4.67E-02 | 0.00E+00 | 0.00E+00 |
| NHWD [kg] | 9.90E+00 | 4.71E+00 | 0.00E+00 | 5.19E+00 |
| HLRW [m3] | 1.76E-03 | 1.76E-03 | 0.00E+00 | 2.88E-08 |
| ILLRW [m3[ | 4.89E-04 | 4.89E-04 | 0.00E+00 | 2.66E-07 |
| CRU [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MR [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MER [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EE [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Additional inventory parameters for transparency** | | | | |
| CCE [kg CO2 eq] | 8.50E+01 | 8.50E+01 | 0.00E+00 | 0.00E+00 |

## Table 5: Cradle to Gate Results for One Metric Tonne Architectural Precast Concrete Produced in the PCI Midwest

| Indicator | A1-A3 | A1 | A2 | A3 |
|---|---|---|---|---|
| **Environmental Impacts** | | | | |
| GWP [kg CO2 eq] | 3.18E+02 | 2.10E+02 | 6.09E+01 | 4.70E+01 |
| ODP [kg CFC 11 eq] | 6.29E-06 | 4.41E-06 | 2.55E-09 | 1.87E-06 |
| EP [kg N eq] | 4.71E-01 | 2.45E-01 | 4.42E-02 | 1.82E-01 |
| AP [kg SO2 eq] | 1.51E+00 | 5.19E-01 | 7.41E-01 | 2.48E-01 |
| POCP [kg O3 eq] | 2.90E+01 | 8.19E+00 | 1.92E+01 | 1.54E+00 |
| **Use of Primary Resources** | | | | |
| RPRE [MJ] | 9.52E+01 | 8.77E+01 | 0.00E+00 | 7.50E+00 |
| RPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRPRE [MJ] | 3.11E+03 | 1.40E+03 | 9.19E+02 | 7.92E+02 |
| NRPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Use of Secondary Resources** | | | | |
| SM [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| RSF [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRSF [MJ] | 9.14E+01 | 9.14E+01 | 0.00E+00 | 0.00E+00 |
| RE [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Abiotic Depletion Potential** | | | | |
| ADPF [MJ] | 2.52E+03 | 1.03E+03 | 8.67E+02 | 6.22E+02 |
| ADPE [kg Sb eq] | 1.79E-04 | 1.63E-04 | 0.00E+00 | 1.59E-05 |
| **Consumption of Freshwater** | | | | |
| FW [m3] | 1.33E+00 | 1.10E+00 | 0.00E+00 | 2.30E-01 |
| **Waste and Output Flows** | | | | |
| HWD [kg] | 4.74E-02 | 4.71E-02 | 0.00E+00 | 3.00E-04 |
| NHWD [kg] | 8.41E+00 | 4.38E+00 | 0.00E+00 | 4.03E+00 |
| HLRW [m3] | 1.76E-03 | 1.76E-03 | 0.00E+00 | 5.79E-08 |
| ILLRW [m3[ | 4.94E-04 | 4.93E-04 | 0.00E+00 | 5.34E-07 |
| CRU [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MR [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MER [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EE [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Additional inventory parameters for transparency** | | | | |
| CCE [kg CO2 eq] | 8.39E+01 | 8.39E+01 | 0.00E+00 | 0.00E+00 |

## Table 6: Cradle to Gate Results for One Metric Tonne Architectural Precast Concrete Produced in the PCI Mountain

| Indicator | A1-A3 | A1 | A2 | A3 |
|---|---|---|---|---|
| **Environmental Impacts** | | | | |
| GWP [kg CO2 eq] | 3.32E+02 | 2.08E+02 | 4.45E+01 | 7.98E+01 |
| ODP [kg CFC 11 eq] | 6.68E-06 | 4.34E-06 | 1.88E-09 | 2.34E-06 |
| EP [kg N eq] | 5.09E-01 | 2.44E-01 | 3.11E-02 | 2.34E-01 |
| AP [kg SO2 eq] | 1.47E+00 | 5.78E-01 | 5.21E-01 | 3.68E-01 |
| POCP [kg O3 eq] | 2.53E+01 | 8.26E+00 | 1.32E+01 | 3.88E+00 |
| **Use of Primary Resources** | | | | |
| RPRE [MJ] | 1.87E+02 | 9.52E+01 | 0.00E+00 | 9.21E+01 |
| RPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRPRE [MJ] | 3.34E+03 | 1.41E+03 | 6.76E+02 | 1.25E+03 |
| NRPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Use of Secondary Resources** | | | | |
| SM [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| RSF [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRSF [MJ] | 8.70E+01 | 8.70E+01 | 0.00E+00 | 0.00E+00 |
| RE [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Abiotic Depletion Potential** | | | | |
| ADPF [MJ] | 2.77E+03 | 1.04E+03 | 6.38E+02 | 1.09E+03 |
| ADPE [kg Sb eq] | 2.14E-04 | 1.79E-04 | 0.00E+00 | 3.49E-05 |
| **Consumption of Freshwater** | | | | |
| FW [m3] | 1.44E+00 | 1.12E+00 | 0.00E+00 | 3.23E-01 |
| **Waste and Output Flows** | | | | |
| HWD [kg] | 4.80E-02 | 4.80E-02 | 0.00E+00 | 0.00E+00 |
| NHWD [kg] | 5.20E+01 | 3.30E+00 | 0.00E+00 | 4.87E+01 |
| HLRW [m3] | 1.76E-03 | 1.76E-03 | 0.00E+00 | 3.56E-08 |
| ILLRW [m3[ | 5.04E-04 | 5.04E-04 | 0.00E+00 | 3.46E-07 |
| CRU [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MR [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MER [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EE [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Additional inventory parameters for transparency** | | | | |
| CCE [kg CO2 eq] | 7.99E+01 | 7.99E+01 | 0.00E+00 | 0.00E+00 |

## Table 7: Cradle to Gate Results for One Metric Tonne Architectural Precast Concrete Produced in the PCI West

| Indicator | A1-A3 | A1 | A2 | A3 |
|---|---|---|---|---|
| **Environmental Impacts** | | | | |
| GWP [kg CO2 eq] | 2.69E+02 | 2.04E+02 | 2.59E+01 | 3.85E+01 |
| ODP [kg CFC 11 eq] | 5.93E-06 | 4.30E-06 | 1.09E-09 | 1.63E-06 |
| EP [kg N eq] | 4.12E-01 | 2.51E-01 | 1.87E-02 | 1.42E-01 |
| AP [kg SO2 eq] | 1.11E+00 | 6.54E-01 | 3.13E-01 | 1.41E-01 |
| POCP [kg O3 eq] | 1.91E+01 | 8.39E+00 | 8.08E+00 | 2.65E+00 |
| **Use of Primary Resources** | | | | |
| RPRE [MJ] | 1.55E+02 | 9.99E+01 | 0.00E+00 | 5.53E+01 |
| RPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRPRE [MJ] | 2.42E+03 | 1.44E+03 | 3.91E+02 | 5.89E+02 |
| NRPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Use of Secondary Resources** | | | | |
| SM [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| RSF [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRSF [MJ] | 8.08E+01 | 8.08E+01 | 0.00E+00 | 0.00E+00 |
| RE [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Abiotic Depletion Potential** | | | | |
| ADPF [MJ] | 1.96E+03 | 1.09E+03 | 3.69E+02 | 5.09E+02 |
| ADPE [kg Sb eq] | 2.21E-04 | 1.98E-04 | 0.00E+00 | 2.31E-05 |
| **Consumption of Freshwater** | | | | |
| FW [m3] | 1.95E+00 | 1.15E+00 | 0.00E+00 | 8.06E-01 |
| **Waste and Output Flows** | | | | |
| HWD [kg] | 1.10E-01 | 4.79E-02 | 0.00E+00 | 6.25E-02 |
| NHWD [kg] | 1.61E+01 | 1.77E+00 | 0.00E+00 | 1.43E+01 |
| HLRW [m3] | 1.77E-03 | 1.77E-03 | 0.00E+00 | 2.21E-08 |
| ILLRW [m3[ | 5.05E-04 | 5.05E-04 | 0.00E+00 | 2.11E-07 |
| CRU [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MR [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MER [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EE [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Additional inventory parameters for transparency** | | | | |
| CCE [kg CO2 eq] | 7.42E+01 | 7.42E+01 | 0.00E+00 | 0.00E+00 |

**Table 8: Cradle to Gate Results for One Metric Tonne Architectural Precast Concrete Produced in the PCI Mid Atlantic (PCIMA) & PCI Northeast (PCINE)**

| Indicator | A1-A3 | A1 | A2 | A3 |
|---|---|---|---|---|
| **Environmental Impacts** | | | | |
| GWP [kg CO2 eq] | 2.59E+02 | 1.90E+02 | 1.86E+01 | 5.04E+01 |
| ODP [kg CFC 11 eq] | 6.39E-06 | 4.10E-06 | 7.80E-10 | 2.29E-06 |
| EP [kg N eq] | 5.15E-01 | 2.29E-01 | 1.36E-02 | 2.73E-01 |
| AP [kg SO2 eq] | 9.15E-01 | 4.20E-01 | 2.28E-01 | 2.67E-01 |
| POCP [kg O3 eq] | 1.51E+01 | 7.35E+00 | 5.92E+00 | 1.80E+00 |
| **Use of Primary Resources** | | | | |
| RPRE [MJ] | 8.38E+01 | 7.57E+01 | 0.00E+00 | 8.08E+00 |
| RPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRPRE [MJ] | 2.35E+03 | 1.25E+03 | 2.81E+02 | 8.20E+02 |
| NRPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Use of Secondary Resources** | | | | |
| SM [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| RSF [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRSF [MJ] | 8.40E+01 | 8.40E+01 | 0.00E+00 | 0.00E+00 |
| RE [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Abiotic Depletion Potential** | | | | |
| ADPF [MJ] | 1.82E+03 | 9.46E+02 | 2.65E+02 | 6.06E+02 |
| ADPE [kg Sb eq] | 1.68E-04 | 1.46E-04 | 0.00E+00 | 2.22E-05 |
| **Consumption of Freshwater** | | | | |
| FW [m3] | 1.41E+00 | 1.03E+00 | 0.00E+00 | 3.80E-01 |
| **Waste and Output Flows** | | | | |
| HWD [kg] | 3.74E-02 | 3.74E-02 | 0.00E+00 | 0.00E+00 |
| NHWD [kg] | 9.15E+00 | 4.18E+00 | 0.00E+00 | 4.98E+00 |
| HLRW [m3] | 1.75E-03 | 1.75E-03 | 0.00E+00 | 8.20E-08 |
| ILLRW [m3[ | 3.90E-04 | 3.89E-04 | 0.00E+00 | 7.52E-07 |
| CRU [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MR [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MER [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EE [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Additional inventory parameters for transparency** | | | | |
| CCE [kg CO2 eq] | 7.71E+01 | 7.71E+01 | 0.00E+00 | 0.00E+00 |

## Table 9: Cradle to Gate Results for One Metric Tonne Architectural Precast Concrete Produced in the PCMA.

| Indicator | A1-A3 | A1 | A2 | A3 |
|---|---|---|---|---|
| **Environmental Impacts** | | | | |
| GWP [kg CO2 eq] | 2.78E+02 | 2.11E+02 | 4.36E+01 | 2.36E+01 |
| ODP [kg CFC 11 eq] | 5.86E-06 | 4.38E-06 | 1.83E-09 | 1.48E-06 |
| EP [kg N eq] | 3.80E-01 | 2.46E-01 | 3.17E-02 | 1.02E-01 |
| AP [kg SO2 eq] | 1.24E+00 | 5.71E-01 | 5.35E-01 | 1.34E-01 |
| POCP [kg O3 eq] | 2.47E+01 | 8.31E+00 | 1.38E+01 | 2.64E+00 |
| **Use of Primary Resources** | | | | |
| RPRE [MJ] | 1.02E+02 | 9.25E+01 | 0.00E+00 | 9.97E+00 |
| RPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRPRE [MJ] | 2.47E+03 | 1.42E+03 | 6.59E+02 | 3.83E+02 |
| NRPRM [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Use of Secondary Resources** | | | | |
| SM [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| RSF [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRSF [MJ] | 8.91E+01 | 8.91E+01 | 0.00E+00 | 0.00E+00 |
| RE [MJ] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Abiotic Depletion Potential** | | | | |
| ADPF [MJ] | 2.00E+03 | 1.05E+03 | 6.21E+02 | 3.30E+02 |
| ADPE [kg Sb eq] | 1.92E-04 | 1.77E-04 | 0.00E+00 | 1.48E-05 |
| **Consumption of Freshwater** | | | | |
| FW [m3] | 2.39E+00 | 1.12E+00 | 0.00E+00 | 1.27E+00 |
| **Waste and Output Flows** | | | | |
| HWD [kg] | 4.90E-02 | 4.90E-02 | 0.00E+00 | 0.00E+00 |
| NHWD [kg] | 2.29E+01 | 3.74E+00 | 0.00E+00 | 1.91E+01 |
| HLRW [m3] | 1.76E-03 | 1.76E-03 | 0.00E+00 | 1.51E-08 |
| ILLRW [m3[ | 5.15E-04 | 5.15E-04 | 0.00E+00 | 1.45E-07 |
| CRU [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MR [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MER [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EE [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Additional inventory parameters for transparency** | | | | |
| CCE [kg CO2 eq] | 8.18E+01 | 8.18E+01 | 0.00E+00 | 0.00E+00 |

## 6.2. SAMPLE MINIMUM AND MAXIMUM

Table 10-11 represent the minimum and maximum values of cradle-to-gate results for all three product categories across the nine regions.

**Table 10: Maximum values for Cradle to Gate results for One Metric Tonne Architectural Precast Concrete Produced in the nine different regions.**

| Indicator | Unit | FPCA | GCPCI/PCI Gulf South | PCI Central | PCI IW | PCI Midwest | PCI Mountain | PCI West | PCIMA/PCINE | PCMA |
|---|---|---|---|---|---|---|---|---|---|---|
| **Environmental Impacts** | | | | | | | | | | |
| GWP | kg CO2 eq. | 3.80E+02 | 3.82E+02 | 3.97E+02 | 3.11E+02 | 3.61E+02 | 3.74E+02 | 3.08E+02 | 2.98E+02 | 3.20E+02 |
| ODP | kg CFC 11 eq. | 9.20E-06 | 9.13E-06 | 9.15E-06 | 6.44E-06 | 7.01E-06 | 7.37E-06 | 6.56E-06 | 7.07E-06 | 6.56E-06 |
| EP | kg N eq. | 5.02E-01 | 6.65E-01 | 6.99E-01 | 3.90E-01 | 5.09E-01 | 5.44E-01 | 4.45E-01 | 5.49E-01 | 4.16E-01 |
| AP | kg SO2 eq. | 1.78E+00 | 1.87E+00 | 1.78E+00 | 1.09E+00 | 1.61E+00 | 1.58E+00 | 1.23E+00 | 9.97E-01 | 1.36E+00 |
| POCP | kg O3 eq. | 4.07E+01 | 3.10E+01 | 3.39E+01 | 1.84E+01 | 3.07E+01 | 2.70E+01 | 2.07E+01 | 1.66E+01 | 2.64E+01 |
| ADPF | MJ | 3.17E+03 | 2.74E+03 | 3.14E+03 | 2.01E+03 | 2.70E+03 | 2.95E+03 | 2.13E+03 | 1.99E+03 | 2.18E+03 |

**Table 11: Minimum values for Cradle to Gate results for One Metric Tonne Architectural Precast Concrete Produced in the nine different regions.**

| Indicator | Unit | FPCA | GCPCI/PCI Gulf South | PCI Central | PCI IW | PCI Midwest | PCI Mountain | PCI West | PCIMA/PCINE | PCMA |
|---|---|---|---|---|---|---|---|---|---|---|
| **Environmental Impacts** | | | | | | | | | | |
| GWP | kg CO2 eq. | 2.97E+02 | 2.87E+02 | 3.11E+02 | 2.24E+02 | 2.75E+02 | 2.90E+02 | 2.29E+02 | 2.20E+02 | 2.35E+02 |
| ODP | kg CFC 11 eq. | 7.92E-06 | 7.59E-06 | 7.69E-06 | 4.98E-06 | 5.57E-06 | 5.99E-06 | 5.30E-06 | 5.71E-06 | 5.16E-06 |
| EP | kg N eq. | 4.36E-01 | 5.85E-01 | 6.24E-01 | 3.15E-01 | 4.34E-01 | 4.73E-01 | 3.79E-01 | 4.81E-01 | 3.44E-01 |
| AP | kg SO2 eq. | 1.61E+00 | 1.49E+00 | 1.58E+00 | 8.84E-01 | 1.40E+00 | 1.35E+00 | 9.85E-01 | 8.33E-01 | 1.12E+00 |
| POCP | kg O3 eq. | 3.73E+01 | 2.72E+01 | 3.04E+01 | 1.49E+01 | 2.72E+01 | 2.36E+01 | 1.75E+01 | 1.35E+01 | 2.30E+01 |
| ADPF | MJ | 2.80E+03 | 2.31E+03 | 2.78E+03 | 1.65E+03 | 2.34E+03 | 2.60E+03 | 1.80E+03 | 1.65E+03 | 1.82E+03 |

## 6.3. INTERPRETATION

Across the production information modules for all regions, module A1 raw material supply contributes the largest share of the impact category results – accounting for roughly 70-80% of the impact burden. The upstream raw material supply (A1) also accounts for the largest share of energy use; almost all of which is drawn from non-renewable energy sources. Raw material transportation (A2) proves to be a minor contributor to the burdens exhibited by precast products. Manufacturing (A3) precast products contributes in the order of 10% of all greenhouse gases and 20% of the primary energy use. Across the product groups there is a correlation between cement use and the global warming potential and energy use results.

## 7 ADDITIONAL ENVIRONMENTAL INFORMATION

*Quality and Environmental Management Systems*
In general, PCI manufacturing facilities follow the ISO 14001 environmental management system, ISO 9001 quality management system or other in-house quality control systems.

## 8 DECLARATION TYPE AND PRODUCT AVERAGE DECLARATION

The type of EPD is defined as:
A “Cradle-to-gate” EPD of regionalized architectural precast concrete products covering the product stage (modules A1 to A3) and is intended for use in Business-to-Business communication.

## 9 DECLARATION COMPARABILITY LIMITATION STATEMENT

The following ISO statement indicates the EPD comparability limitations and intent to avoid any market distortions or misinterpretation of EPDs based on the NSF's Precast Concrete PCR: 2021:
- EPDs from different programs (using different PCR) may not be comparable.
- Declarations based on the NSF Precast Concrete PCR are not comparative assertions; that is, no claim of environmental superiority may be inferred or implied.

## 10 EPD EXPLANATORY MATERIAL

For any explanatory material, in regard to this EPD, please contact the program operator.
ASTM International
Environmental Product Declarations
100 Barr Harbor Drive,
West Conshohocken,
PA 19428-2959, http://www.astm.org

## 11 REFERENCES

1. ISO 14044: 2006 Environmental Management – Life cycle assessment – Requirements and Guidelines.
2. ISO 14044: 2006/ Amd 1:2017 Environmental Management – Life cycle assessment – Requirements and Guidelines – Amendment 1.
3. ISO 14044: 2006/ Amd 2:2020 Environmental Management – Life cycle assessment – Requirements and Guidelines – Amendment 2.

4. ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.
5. ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.
6. EPA PCR Guidance Document: U.S. EPA Criteria for Product Category Rules (PCRs) to Support the Label Program for Low Embodied Carbon Construction Materials (EPA's PCR Criteria) (Version 1—2024)
7. IPCC AR5: IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp
8. CED V1.10 NCV: Cumulative Energy Demand (CED) V1.10
9. NSF/ASTM International, Product Category Rules for Precast Concrete, UNCPC: 37550 Version 3 (April 30, 2021)

# APPENDIX A – SECONDARY DATASETS

**Table A1: Datasets used in the A1 Module of this LCA**

| Flow Ref. | Materials | LCI Data Source | Year / Region | Data Quality Assessment |
|---|---|---|---|---|
| A1-1 | GU and GUL Cement<br>*ASTM C150, C595, C1157* | Portland Cement Association EPD of Portland Cement and Portland Limestone Cement (2021) | 2021<br>North America | • Technology: very good<br>• Time: very good<br>• Geography: very good<br>• Completeness: very good<br>• Reliability: very good |
| A1-2 | Fly Ash<br>*ASTM C618* | None, no incoming burden, only transport is considered | N/A | • N/A<br>• Recovered material |
| A1-3 | Silica Fume<br>*ASTM c1240* | None, no incoming burden, only transport is considered | N/A | • N/A<br>• Recovered material |
| A1-4 | Slag Cement<br>*ASTM C989* | Slag Cement Association EPD of North America Slag Cement (2021) | 2021<br>North America | • Technology: very good<br>• Time: very good<br>• Geography: very good<br>• Completeness: very good<br>• Reliability: very good |
| A1-5 | Crushed Aggregates<br>*coarse and fine*<br>*ASTM C33* | ecoinvent 3.9: "Gravel, crushed {RoW}\| production \| Cut-off, U"<br>Modified foreground process with region-specific electricity grid. | 2024<br>World/<br>Regional | • Technology: very good<br>• Time: poor<br>• Geography: good<br>• Completeness: very good<br>• Reliability: very good |
| A1-6 | Natural Aggregates<br>*coarse and fine*<br>*ASTM C330* | ecoinvent 3.9: "Gravel, round {RoW}\| gravel and sand quarry operation \| Cut-off, U"<br>Modified foreground process with region-specific electricity grid. | 2024<br>World/<br>Regional | • Technology: very good<br>• Time: poor<br>• Geography: good<br>• Completeness: very good<br>• Reliability: very good |
| A1-7 | Pelletized Slag | Slag Cement Association EPD of North America Slag Cement, Module A1 (2021) | 2021<br>North America | • Technology: very good<br>• Time: very good<br>• Geography: very good<br>• Completeness: very good<br>• Reliability: very good |
| A1-8 | Admixtures<br>*ASTM C494* | EFCA EPDs for Air Entrainers, Plasticisers and superplasticisers, Hardening Accelerators, Set Accelerators, Water Resisting Admixtures, and Retarders (2015) [8]<br>Non-supported LCIA indicators estimated – adjusted using TRACI equivalents | 2022 EU | • Technology: very good<br>• Time: very good<br>• Geography: fair<br>• Completeness: good<br>• Reliability: very good |

| Flow Ref. | Materials | LCI Data Source | Year / Region | Data Quality Assessment |
|---|---|---|---|---|
| A1-9 | Batch and Wash Water<br>*ASTM C1602* | ecoinvent 3.9:<br>Tap water {RoW}\| market for \| Cut-off, U | 2024<br>World/<br>USA | • Technology: very good<br>• Time: good<br>• Geography: good<br>• Completeness: very good<br>• Reliability: very good |
| A1-10 | Steel Plate | American Iron and Steel Institute – Life Cycle Inventories of North American Steel Products (2020) – wire and plate | 2017 USA | • Technology: very good<br>• Time: very good<br>• Geography: good<br>• Completeness: very good<br>• Reliability: very good |
| A1-11 | Rebar, Welded Wire, Steel Stressing Strand* | Concrete Reinforcing Steel Institute EPD for Steel Reinforcement Bar (2020) – *Adjusted by factor 1.10 for Steel Stressing Strand | 2022 North America | • Technology: very good<br>• Time: very good<br>• Geography: good<br>• Completeness: very good<br>• Reliability: very good |
| A1-12 | Lightweight Aggregates | Ecoinvent 3.9:<br>**Expanded clay {RoW}\| production \| Cut-off U** | 2024<br>World/<br>USA | • Technology: very good<br>• Time: good<br>• Geography: good<br>• Completeness: very good<br>• Reliability: very good |
| A1-13 | Glass Fiber | Ecoinvent 3.9:<br>**Glass fiber,** {RoW}\| market for \| Cut-off, U | 2024<br>World/<br>USA | • Technology: very good<br>• Time: good<br>• Geography: good<br>• Completeness: very good<br>• Reliability: very good |
| A1-14 | Expanded Polystyrene and **Waste expanded polystyrene** | **EPD: EPS Industry Alliance: Expanded Poystyrene (EPS) Insulation Type VIII; Waste expanded polystyrene {GLO}\| market for \| APOS, S** | 2023 North America | • Technology: very good<br>• Time: good<br>• Geography: good<br>• Completeness: very good<br>• Reliability: very good |

**Table A2: Datasets used in the A2 Module of this LCA**

| Flow Ref. | Process | LCI Data Source | Year / Region | Data Quality Assessment |
|---|---|---|---|---|
| A2-1 | Road | USLCI 2014:<br>Transport, combination Truck, short-haul, diesel powered/tkm/RNA (2014) [13] | 2014<br>USA | • Technology: very good<br>• Time: good<br>• Geography: very good<br>• Completeness: very good<br>• Reliability: very good |
| A2-2 | Rail | USLCI 2014:<br>Transport, train, diesel powered /US U (2014) [13] | 2014<br>USA | • Technology: very good<br>• Time: fair<br>• Geography: very good<br>• Completeness: very good<br>• Reliability: very good |
| A2-3 | Ocean | USLCI 2014:<br>Transport, Ocean freighter, average fuel mix /US U (2014) [13] | 2014<br>USA | • Technology: very good<br>• Time: fair<br>• Geography: very good<br>• Completeness: very good<br>• Reliability: very good |
| A2-4 | Barge | USLCI 2014:<br>Transport, Barge, average fuel mix /US U (2014) [13] | 2014<br>USA | • Technology: very good<br>• Time: fair<br>• Geography: very good<br>• Completeness: very good<br>• Reliability: very good |

**Table A3: Datasets used in the A3 Module of this LCA**

| Flow Ref | Process | LCI Data Source | Year / Region | Data Quality Assessment |
|---|---|---|---|---|
| A3-1 | Electricity | ecoinvent 3.9:<br>Electricity, low voltage {XX}\| market for \| Cut-off, U (2018) [18] | 2024<br>North America | • Technology: very good<br>• Time: very good<br>• Geography: very good<br>• Completeness: very good<br>Reliability: very good |
| A3-2 | Natural Gas | USLCI 2014:<br>Natural Gas, combusted in industrial boiler /US U (2014) | 2014<br>USA | • Technology: very good<br>• Time: fair<br>• Geography: very good<br>• Completeness: very good<br>• Reliability: very good |
| A3-3 | Diesel | USLCI 2014:<br>Diesel, combusted in industrial equipment /US U (2014) [13] | 2014<br>USA | • Technology: very good<br>• Time: fair<br>• Geography: very good<br>• Completeness: very good<br>Reliability: very good |
| A3-4 | Gasoline | USLCI 2014:<br>Gasoline, combusted in equipment /US U (2014) [13] | 2014<br>USA | • Technology: very good<br>• Time: fair<br>• Geography: very good<br>• Completeness: very good<br>• Reliability: very good |

| Flow Ref | Process | LCI Data Source | Year / Region | Data Quality Assessment |
|---|---|---|---|---|
| A3-5 | Liquefied Propane Gas | USLCI 2014:<br>Liquefied petroleum gas, combusted in industrial boiler /US U (2014) [13] | 2014<br>USA | • Technology: very good<br>• Time: fair<br>• Geography: very good<br>• Completeness: very good<br>• Reliability: very good |
| A3-6 | Hazardous Solid Waste, | ecoinvent 3.9:<br>Hazardous waste, for incineration {RoW}\| treatment of hazardous waste, hazardous waste incineration \| Alloc Rec, U (2018) [18] | 2024<br>World/<br>USA | • Technology: very good<br>• Time: good<br>• Geography: good<br>• Completeness: very good<br>• Reliability: very good |
| A3-7 | Non-Hazardous Solid Waste | ecoinvent 3.9:<br>Inert waste {RoW}\| treatment of, sanitary landfill \| Alloc Rec, U (2018) [18]<br><br>Modified foreground process with United States average electricity grid | 2024<br>World/<br>USA | • Technology: very good<br>• Time: good<br>• Geography: good<br>• Completeness: very good<br>• Reliability: very good |

# APPENDIX B – PARTICIPATING COMPANIES

| Company | Facility | PCI Reporting Region |
|---|---|---|
| ATMI Precast | ATMI Indy | PCI Central |
| | ATMI Aurora | PCI-IW |
| Boccella Precast | Boccella NJ | PCIMA/PCINE |
| Clark Pacific | Adelanto, CA | PCI West |
| | Woodland, CA | PCI West |
| Con-Fab California, LLC | Lathrop, CA | PCI West |
| Concrete Building Systems | Delaware | PCIMA/PCINE |
| Concrete Industries, Inc. | Nebraska | PCI Midwest |
| Concrete Technology Corporation | Washington | PCI West |
| Coreslab Structures Inc. | Coreslab Structures (Missouri) | PCI Midwest |
| | Coreslab Structures (ARIZ) Inc. | PCI West |
| | Coreslab Structures (Indianapolis) Inc. | PCI Central |
| | Coreslab Structures (OKLA) Inc | PCMA |
| | CoreSlab Tampa | FPCA |
| | CoreSlab Perris, CA | PCI West |
| County Prestress | Illinois | PCI-IW |
| East Texas Precast | East Texas Precast | PCMA |
| EnCon United | EnCon Colorado | PCI Mountain States |
| | Stresscon | PCI Mountain States |
| | EnCon Arizona | PCI West |
| Fabcon | Grandville, MI | PCI Central |
| | Grove City, OH | PCI Central |
| | Mahanoy City, PA | PCIMA/PCINE |
| | Pleasanton, KS | PCI Midwest |
| | Savage, MN | PCI Midwest |
| | Selkirk, NY | PCIMA/PCINE |
| | Trenton, MI | PCI Central |
| Finfrock | Florida | FPCA |
| Gage Brothers | Sioux Falls, SD | PCI Midwest |
| Gate Precast | Ashland City, TN | PCI Central |
| | Kissimmee, FL | FPCA |
| | Jacksonville, FL | FPCA |
| | Hillsboro, TX (Arch and Structural Plants) | PCMA |
| | Monroeville, AL | GCPCI/PCI Gulf South |
| High Concrete Group LLC | Denver, PA | PCIMA/PCINE |

| | | |
|---|---|---|
| Joseph P.Cararra & Sons | Vermont | PCIMA/PCINE |
| Knife River Precast | Harrisburg, OR | PCI West |
| | Newman Lake, WA | PCI West |
| Lindsay Precast | Lindsay North Carolina | GCPCI/PCI Gulf South |
| | Lindsay South Carolina | GCPCI/PCI Gulf South |
| Metromont | Bartow, FL | FPCA |
| | Greenville, SC | GCPCI/PCI Gulf South |
| | Hiram, GA | GCPCI/PCI Gulf South |
| | Richmond, VA | PCIMA/PCINE |
| | Spartanburg, SC | GCPCI/PCI Gulf South |
| | Winchester, VA | PCIMA/PCINE |
| Molin | Lino Lakes, MN | PCI Midwest |
| | Ramsey, MN | PCI Midwest |
| Mid-States Concrete Industries, LLC | Illinois | PCI-IW |
| Dailey Precast LLC, A Peckham Family Company | Dailey Precast | PCIMA/PCINE |
| Plum Creek Structures | Plum Creek, CO | PCI Mountain States |
| Prestress Services | Kentucky | PCI Central |
| Tindall Corporation | Spartanburg, SC | GCPCI/PCI Gulf South |
| | Petersburg, VA | PCIMA/PCINE |
| | Moss Point, MS | GCPCI/PCI Gulf South |
| United Concrete Products | Connecticut | PCIMA/PCINE |
| Wells | Crystal Lake, MN | PCI Midwest |
| | Valders, MN | PCI Midwest |
| | Albany, MN | PCI Midwest |
| | Rosemount, MN | PCI Midwest |
| | Wells, MN | PCI Midwest |
| | Brighton, CO | PCI Mountain States |
| Willis Construction | San Juan Bautista, CA | PCI West |