CastWorks® GFRC Architectural Forms

Armstrong®
World Industries

In Accordance with
ISO 14025 and ISO 21930:2017

Life Cycle Impact Categories (A1-A3) for 1 metric tonne

Cradle-to-Gate environmental impacts for 1 metric tonne of CastWorks® GFRC Architectural Forms

Embodied Carbon (GWP_{100}) (excluding biogenic carbon)
7.47E+02 kg $CO_{2\ eq.}$

Acidification Potential
2.13E+00 kg $SO_{2\ eq.}$

Photochemical Oxidation Formation
5.12E+01 kg $O_{3\ eq.}$

Eutrophication Potential - Freshwater
4.30E-04 kg $P_{eq.}$

Ozone Depletion Potential
2.98E-09 kg CFC 11 $_{eq.}$

Eutrophication Potential - Marine
1.28+00 kg $N_{eq.}$

CastWorks® GFRC Architectural Forms



Committed to Sustainability

Armstrong World Industries leads in delivering solutions that meet today's most stringent industry sustainability standards. We are committed to environmental responsibility in all aspects of our business, and carbon reduction is part of our 2030 Company goals and ambitions. We were one of the first companies to create and publish the Environmental Product Declaration (EPD) in Building Product Industry. We have over a decade of experience using Life Cycle Assessment (LCA) to evaluate environmental impacts of our products starting with design, to raw materials, and through our operations. We are constantly working to optimize our operations and products to reduce their environmental impact. We believe the use of LCA and our commitment to transparency of our products' carbon footprint is critical to contributing to decarbonization of the built environment.

Contents

Product application and use
Product ingredients and their sources
How the product is produced
LCA results, including global warming potential and primary energy usage
Total impacts over the product life cycle

For more information visit
armstrong.com/transparency

ASTM INTERNATIONAL

CastWorks® GFRC Architectural Forms

In Accordance with ISO 14025 and ISO 21930:2017

1. CONTENT OF THE EPD

EPD Program & Program Operator Name, Address, Logo, and Website	ASTM International – 100 Barr Harbor Drive West Conshohocken, PA, 19428, USA
General Program Instructions & Version Number	ASTM Program Operator for Product Category Rules (PCR) and Environmental Product Declarations (EPDs), General Program Instructions, Version: 8.0, Revised 04/29/20
Manufacturer Name & Address	Armstrong World Industries 2500 Columbia Avenue Lancaster, PA 17603
Declaration Number	EPD 1204
Declared Product & Declared Unit	1 metric tonne (1000 kg) of Glass Fiber Reinforced Concrete
Reference PCR & Version Number	NSF International Product Category Rules (PCR) for Environmental Product Declarations: PCR for Precast Concrete – UNCPC: 37550, V3.0, May 2021
Description of Product's Intended Application & Use (As Identified When Determining Product RSL)	CastWorks® Glass Fiber Reinforced Concrete Architectural Forms
Product RSL Description *(if appl.)*	N/A
Markets of Applicability	Glass-fiber-reinforced concrete products satisfy a wide array of applications
Date of Issue	June 2026
Period of Validity	5 years
EPD Type	Product-Specific
Dataset Variability	Industry Average Only
EPD Scope	Cradle to Gate
Year(S) of Reported Manufacturer Primary Data	2022
LCA Software & Version Number	Sphera® for Experts, version 10.9.3.0
LCI Database(S) & Version Number	MLC Datebase (formerly Gabi) 2025.1
LCIA Methodology & Version Number	TRACI 2.2, CML v4.7 2016
The Sub-Category PCR Review Was Conducted By:	Dr. Thomas P. Gloria, PhD, t.gloria@industrial-ecology.com Mr. Bill Stough Dr. Michael Overcash
This Declaration Was Independently Verified In Accordance with ISO 14025: 2006. NSF International Product Category Rules for Environmental Product Declarations: PCR for Precast Concrete Serves as the Core PCR. ☐ Internal ☒ External	Tim Brooke, ASTM International
The EPD conforms with (select one):	☒ ISO 21930:2017 ☐ EN 15804:2013+A1:2014 ☐ EN 15804:2013+A2:2019 ☒ ISO 14025: 2006
This Life Cycle Assessment Was Conducted in Accordance with ISO 14044 and The Reference PCR by:	Armstrong World Industries, Inc.
This Life Cycle Assessment was Independently Verified in Accordance with ISO 14044 and the Reference PCR by:	 Lindita Bushi, PhD, Athena Sustainable Materials Institute
Limitations	

Environmental declarations from different programs (ISO 14025) may not be comparable.

Comparison of the environmental performance using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR.

Full conformance with this PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences in results for upstream or downstream of the life cycle stages declared.

CastWorks® GFRC Architectural Forms

In Accordance with ISO 14025 and ISO 21930:2017

2. GENERAL INFORMATION

2.1 DESCRIPTION OF ORGANIZATION

Armstrong World Industries, Inc. (AWI) is a leader in the design and manufacture of building products in the Americas. At home, at work, in healthcare facilities, classrooms, stores, or restaurants, Armstrong World Industries offers interior solutions that help to enhance comfort, save time, improve building efficiency and overall performance, and create beautiful spaces.

2.2 PRODUCT DESCRIPTION

CastWorks® Glass Fiber Reinforced Concrete (GFRC) is a lightweight portland cement composite material reinforced with glass fibers that is an economical alternative to precast concrete. UNCPC for the architectural form is 37550 and the Construction Specification Institute (CSI) is 03 49 00.

2.2.1 Product-Specific EPD

Castworks® GFRC is manufactured by Armstrong World Industries in Ontario, Canada (L5E 1E9).

2.2.2 Product Specification

Refer to CastWorks GFRC specification 03 49 00 on Armstrong Website.

Table 1. Product Specification

Specification	Description
PCI-128	Specification for Glass-Fiber-Reinforced Concrete Panels

2.2.3 Flow Diagram

CastWorks GFRC products are manufacturered using a forming process which is shown in the flow diagram below.

2.3 PRODUCT AVERAGE

2.3.1 Product-Specific EPD

This EPD is specific to CastWorks® GFRC. Inputs were developed based on 2022 production volumes and weights for CastWorks® GFRC products.

2.4 APPLICATION

The products covered by this EPD are designed to be installed with (but not limited to) light gauge metal framing.

2.5 MATERIAL COMPOSITION

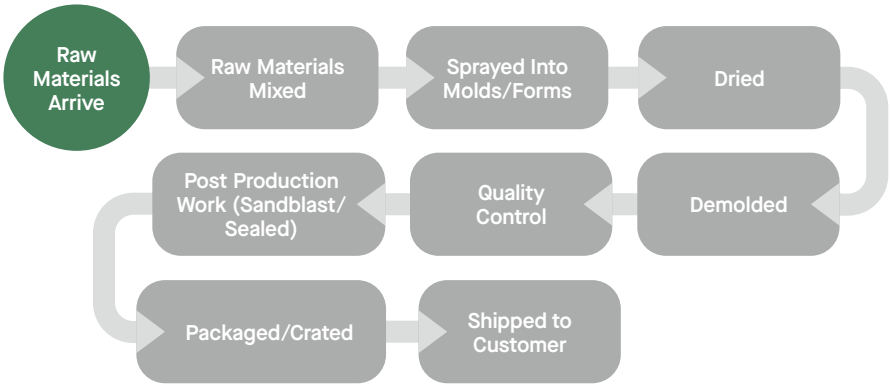
Major raw materials used in GFRC architectural forms manufacturing are summarized in the table below.

Table 2. Material Composition

Material	CastWorks® GFRC
Portland Cement	40-45%
Sand	35-40%
Batch Water	9-10%
Polymer	6-7%
Glass Fiber	3-4%
Metakaolin	1-2%
Set Accelerator	<1%
Stainless Steel	<1%
Pigment	<1%
Water Reducing Admixture	<1%
Sealer	<1%

2.6 PROPERTIES OF DECLARED PRODUCT AS DELIVERED

The final EPD is available on the Armstrong website.



CastWorks® GFRC Architectural Forms

In Accordance with ISO 14025 and ISO 21930:2017

3. METHODOLOGICAL FRAMEWORK

This study provides life cycle inventory and environmental impacts relevant to Armstrong® CastWorks GFRC. The LCA follows an attributional approach as outlined in ISO 21930 Section 7.1.1.

3.1 DECLARED UNIT

The declaration refers to the declared unit 1 metric tonne (1000 kg) of installed architectural forms, as defined by the PCR.

3.2 DECLARED UNIT PROPERTIES

Table 3. Functional or Declared Unit Properties

	CastWorks® GFRC
Declared Unit – *metric tonne (kg)*	1 (1000)

3.3 SYSTEM BOUNDARY

The scope of the study includes raw material production, transportation, and packaging. Production of capital equipment, facilities, and infrastructure required for manufacture are outside the scope of this assessment. Details of inclusions and exclusions from the system boundary are listed in *Table 4*.

Table 4. Elements Included in the Cradle To Gate

Includes

- Raw materials production (A1)
- Inbound transport of raw materials to production facility (A2)
- Manufacturing of architectural forms (A3)
- Electricity and fuel combustion (A3)
- Packaging of final products (A3)

Excludes

- Construction of capital equipment and other infrastructure flows
- Maintenance and operation of support equipment
- Human labor and employee transport
- Manufacture and transport of packaging materials not associated with final product
- Transportation to the job site (A4)
- Installation and installation waste (A5)
- Deconstruction – manual, no impact (C1)
- End of life, including transport (C2-C4)
- Use Phase (B1 to B7)
- Benefits and loads beyond the system boundary (D)

3.4 REFERENCE SERVICE LIFE AND ESTIMATED BUILDING SERVICE LIFE

In accordance with the PCR, because this PCR does not address module B (Use), the Reference Service Life (RSL) of precast concrete is not addressed.

3.5 ALLOCATION

Allocation at the manufacturing plant was based on the surface-based production volume (ft^2). This is the basis on which products are processed and sold, regardless of product weight. No burdens are allocated across the system boundary with secondary material, secondary fuel, or recovered energy flows arising from waste. Allocation of background data (energy and materials) was taken from the Sphera LCA FE database.

3.6 CUT-OFF RULES

No known flows are deliberately excluded from this EPD. The system boundary was defined based on relevance to the goal of the study. For the processes within the system boundary, all available energy and material flow data have been included in the model. In cases where no matching life cycle inventories are available to represent a flow, proxy data have been applied based on conservative assumptions regarding environmental impacts.

3.7 DATA SOURCES

Primary data for this study was collected from the manufacturing facility for 2022 and datasets for materials upstream from manufacturing were obtained from the Sphera LCA FE database.

3.8 DATA QUALITY

The data quality ranges from good to very good. The temporal quality of the data is very good with both manufacturing-specific data and MLC Database (formerly GaBi) background data from 2022. Because primary and secondary data were collected specifically to the location of manufacture when possible, geographical representativeness is considered to be good.

3.9 PERIOD UNDER REVIEW

All the primary data in the scope of this analysis was collected from Armstrong manufacturing facilities during 2022.

3.10 COMPARABILITY AND BENCHMARKING

We do not have any data on comparable non-competitive products to report.

3.11 ESTIMATES AND ASSUMPTIONS

The datasets for materials upstream from manufacturing are from the Sphera LCA FE database. When inventories were not available for materials, conservative proxy datasets were chosen based on similarity of material. Some LCA impact categories and inventory items are still under development and can have high levels of uncertainty. To promote uniform guidance on the data collection, calculation, and reporting of results, the ACLCA methodology (ACLCA 2019) was used. The indicators on the emissions and uptake of CO2 due to carbonation shall be separately reported, where available, in the relevant module in the quantification of the GWP.

3.12 UNITS

Units commonly used in the North American market are included in addition to the required SI units.

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4. TECHNICAL INFORMATION & SCENARIOS

The majority of Castworks® Glass Fiber Reinforced Concrete (GFRC) products are distributed within 800 kilometers of the respective manufacturing plants. Transportation emissions and fuels throughout the life cycle phases are included. All transportation associated with raw materials reflect the actual modes of transportation and mileage.

4.1 MANUFACTURING

The manufacturing process has been described in a simple flow chart in Section 2.2.4.

4.2 PACKAGING

Castworks® Glass Fiber Reinforced Concrete (GFRC) are placed on wood pallets and shipped.

4.3 PRODUCT INSTALLATION

CastWorks® Glass Fiber Reinforced Concrete (GFRC) must be installed per manufacturing installation requirements.

4.4 USE

A product's RSL depends on the product properties and reference in-use conditions. because this PCR does not address module B (Use), the Reference Service Life (RSL) of precast concrete is not addressed.

5. ENVIRONMENTAL INDICATORS DERIVED FROM LCA

5.1 LCA RESULTS FROM LCIA

The Life Cycle Assessment (LCA) was performed according to ISO 14040 guidelines and follows the specific PCR instructions. The cradle-to-gate LCA consists of raw material production, transport of raw materials to production facility prior to processing, manufacturing of panels, and packaging.

5.2 LCA RESULTS FROM LCIA

Life cycle impacts reported below are based on TRACI 2.2 methodology. Results are provided in reference to the declared unit. For the other impact categories, results are presented in the tables below using the ISO 21930 standard and for the declared unit. Table 6 includes Global Warming Potential (GWP) excluding biogenic. LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. These six impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.

*Table 5. Description of the System Boundary Modules**

(X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

					EPD Type *Cradle to Gate*
Production	*A1*	Raw Material Supply			×
	A2	Transport			×
	A3	Manufacturing			×
Construction	*A4*	Transport to site			MND
	A5	Assembly/Install			MND
Use	*B1*	Use	B6 Operational Energy Use of Building Integrated System During Product Use	B7 Operational Water Use of Building Integrated System During Product Use	MND
	B2	Maintenance			MND
	B3	Repair			MND
	B4	Replacement			MND
	B5	Refurbishment			MND
	B6	Operational Energy Use			MND
	B7	Operational Water			MND
End of Life	*C1*	Deconstruction			MND
	C2	Transport			MND
	C3	Waste processing			MND
	C4	Disposal			MND
Benefits & Loads Beyond System Boundary	*D*	Reuse, Recovery, Recycling Potential			MND

** Results for modules A1-A3 results are aggregated, as described in the PCR.*

CastWorks® GFRC Architectural Forms

In Accordance with ISO 14025 and ISO 21930:2017

*Table 6. TRACI 2.2 Impact Assessment for 1 metric tonne (1000 kg) of CastWorks® GFRC **

Parameter	Source	Unit	A1	A2	A3
GWP 100, excluding biogenic	TRACI 2.2	*kg $CO_{2\,eq.}$*	6.87E+02	1.47E+01	4.53E+01
ODP	TRACI 2.2	*kg CFC 11 $_{eq.}$*	1.06E-09	3.95E-12	1.92E-09
AP	TRACI 2.2	*kg $SO_{2\,eq.}$*	1.90E+00	1.69E-01	6.50E-02
EP - Freshwater	TRACI 2.2	*kg $P_{eq.}$*	3.68E-04	8.47E-06	5.35E-05
EP - Marine	TRACI 2.2	*kg $N_{eq.}$*	1.14E+00	9.78E-02	4.13E-02
SFP	TRACI 2.2	*kg $O_{3\,eq.}$*	4.65E+01	3.25E+00	1.39E+00
ADP Fossil	CML 2001	*MJ*	5.42E+03	1.83E+02	7.05E+02

5.3 LCA RESULTS FROM LCI

*Table 7. LCA Results – Resource Use for 1 metric tonne of CastWorks® GFRC **

Parameter		Unit	A1	A2	A3
RPRe	Renewable primary resources used as energy carrier (fuel)	*MJ, LHV*	9.14E+02	5.86E+00	1.56E+03
RPRm	Renewable primary resources with energy content used as material	*MJ, LHV*	1.63E-02	0.00E+00	0.00E+00
NRPRE	Non-renewable primary resources used as an energy carrier (fuel)	*MJ, LHV*	5.95E+03	1.85E+02	3.94E+03
NRPRM	Non-renewable primary resources with energy content used as material	*MJ, LHV*	2.81E+01	0.00E+00	0.00E+00
SM	Secondary materials	*kg*	0.00E+00	0.00E+00	0.00E+00
RSF	Renewable secondary fuels	*kg*	0.00E+00	0.00E+00	0.00E+00
NRDF	Non-renewable secondary fuels	*m^3*	0.00E+00	0.00E+00	0.00E+00
RE	Recovered Energy	*MJ, LHV*	0.00E+00	0.00E+00	0.00E+00
FW	Use of net fresh water	*m^3*	1.64E+00	6.46E-03	2.51E+00

CastWorks® GFRC Architectural Forms

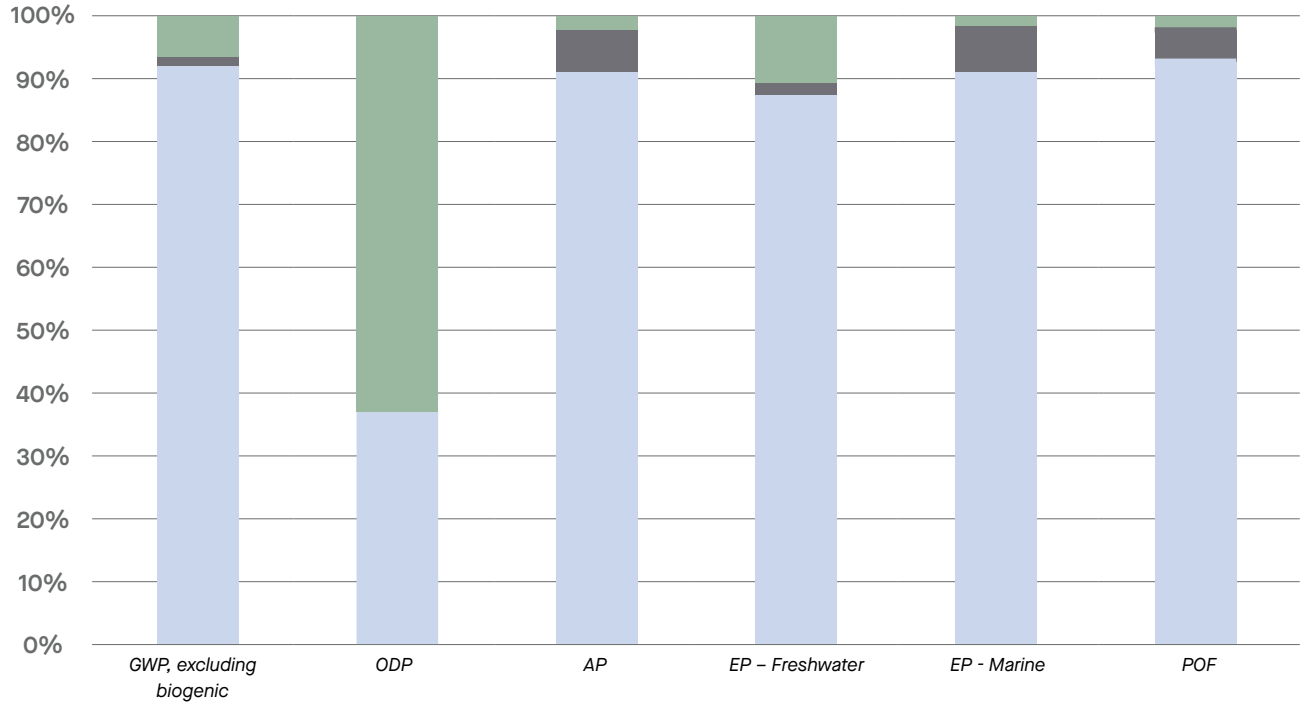
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*Table 8. LCA Results – Output Flows & Waste Categories for 1 metric tonne (1000kg) of CastWorks® GFRC **

Parameter		Unit	A1	A2	A3
HWD	Hazardous waste disposed	*kg*	1.85E-06	3.09E-08	2.85E-06
NHWD	NHWD Non-hazardous waste disposed	*kg*	6.30E+01	1.68E-02	6.22E-01
HLRW	HLRW High-level radioactive waste, conditioned, to final repository	*kg*	2.35E-04	7.44E-07	1.39E-03
ILLRW	Intermediate- and low-level radioactive waste, conditioned, to final repository	*kg*	2.00E-01	6.24E-04	1.15E+00
CRU	Components for re-use	*kg*	0.00E+00	0.00E+00	0.00E+00
MFR	Materials for recycling	*kg*	0.00E+00	0.00E+00	0.00E+00
MER	Materials for energy recovery	*kg*	0.00E+00	0.00E+00	0.00E+00
EE	Recovered energy exported from the product system	*MJ*	0.00E+00	0.00E+00	0.00E+00

6. LCA: INTERPRETATION

The life cycle covered in this study concluded that the manufacturing process and raw materials have the greatest impact on "carbon footprint" as represented by Global Warming Potential [GWP].



Life Cycle Impact Assessment of the architectural forms[1] relative importance in percentage terms for the Production for the GFRC panel.

[1] *Based on U.S. EPA TRACI 2.2 Impact Factors*

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7. ADDITIONAL ENVIRONMENTAL INFORMATION

7.1 ENVIRONMENT & HEALTH DURING MANUFACTURING

Armstrong World Industries has a comprehensive environmental, health, and safety management program. Risk reduction begins in the product design process. All products go through a safety, health, and environmental review prior to sale. Armstrong also has a long-standing commitment to the safety and health of all our employees.

Armstrong World Industries is equally committed to reducing our environmental impact. As with safety goals, each manufacturing facility has environmental initiatives focused on responsible use of energy and water, and on waste reduction. This sub-category PCR recognizes fly ash, silica fume, and granulated blast 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. No “green” power certificates are used in this EPD.

7.2 ENVIRONMENT & HEALTH DURING INSTALLATION

All recommendations shall be utilized as indicated by SDS and installation guidelines. Specific product SDS and installation instructions can be downloaded at: *armstrong.com/pdbupimages-clg/217521.pdf*

7.3 ENVIRONMENTAL ACTIVITIES & CERTIFICATIONS

All environmental certifications can be found at: *armstrong.com*

7.4 FURTHER INFORMATION

Additional Information can be found at: *armstrong.com*

8. PROJECT REPORT & SUPPORTING DOCUMENTATION

This study provides life cycle inventory and environmental impacts relevant to Armstrong® GFRC architectural forms. This report is intended to fulfill the reporting requirements in NSF International Product Category Rules (PCR) for Environmental Product Declarations: PCR for Precast Concrete – UNCPC: 37550, V3.0, May 2021.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.

Armstrong World Industries has a robust internal Quality Assurance process that is based on industry-accepted best practices and is led by a team of quality professionals who have been certified by the American Society for Quality. The process involves several hundred different measures made throughout the manufacturing processes.

9. REFERENCE

Armstrong World Industries. [2025]. CastWorks® GFRC Architectural Forms Life Cycle Assessment Report [Internal unpublished report]

ASTM International General Program instructions, v8.0, April 29, 2020

CML v 4,7 August 2016

ISO 14025:2006 – Environmental labels and declarations – Type III environmental declarations – Principles and procedures

ISO 14040/Amd1:2020 – Environmental management – Life Cycle Assessment – Principles and framework

ISO 14044:2006/Amd1;2017/Amd2:2020, Environmental management — Life Cycle assessment — Requirements and guidelines

ISO 21930:2017 – Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services

NSF International Product Category Rules (PCR) for Environmental Product Declarations: PCR for Precast Concrete – UNCPC: 37550, V3.0, May 2021.

ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017. May 2019

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