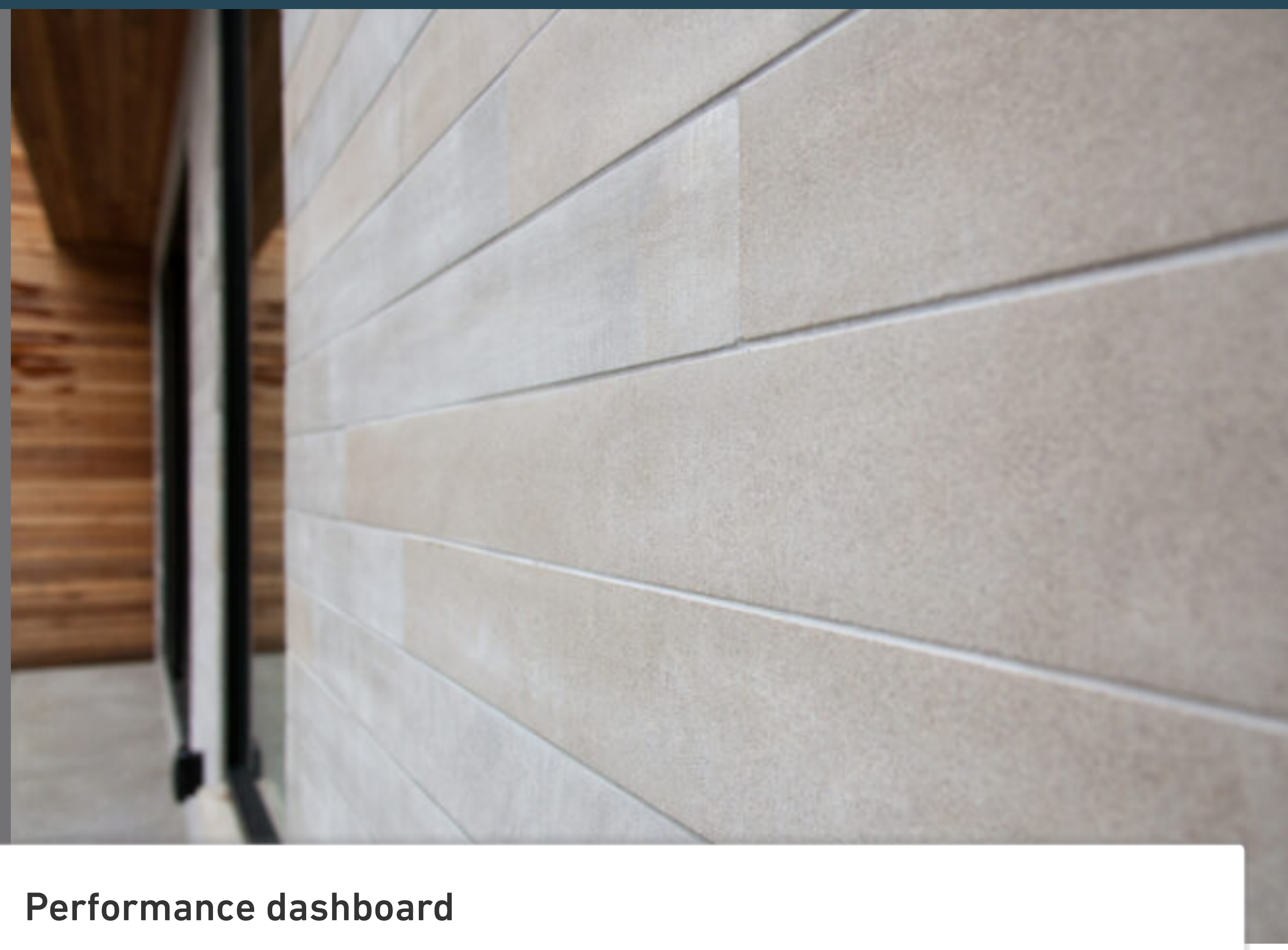
POLYCOR

Limestone Facades, Cladding & Walls

Originating at the Polycor quarries and through production, limestones are manufactured to the system's specifications from ultra-thin profiles up to full thickness dimensional elements complimenting a wide range of façade structures. Limestone is an inherently nonemitting source of VOCs and its durability allows it to perform impeccably in commercial & residential applications, interior or exterior.



Polycor Limestone Cladding LCIA results show a 32% reduction in global warming potential impacts compared to the industry average.

This product-specific EPD compares results to the NSI industry-wide Type III EPD, a product group benchmark done in conformance with benchmarking guidance in the UL PCR and the SM Part B: Benchmarking Addendum.

Performance dashboard

Features & functionality

Covers the wide selection of Polycor's heritage limestones and any surface finishes available

Has an unmatched durability and no need for periodic cleaning

Includes ultra-thin panels and veneer series : BERKSHIRE®, ROCKFORD ESTATE BLEND® & VANDERBILT CLASSIC®

Installation methods include adhered or anchored

Visit Polycor for more product information

Limestones
Building Facades
Veneer series

Environment & materials

Improved by:

Polycor's commitment to carbon neutrality translates into:

Reduction of product's GWP

Reduction of product's energy intensity

Polycor's ownship of the chain of custody from quarries to plants ensures:

No child labor and forced labor

Materials remain 100% natural, free from chemicals or dyes

Certifications & rating systems:

Environmental Product Declaration (EPD)

Natural Stone Sustainability Standard (ANSI 373)

Health Product Declaration (HPD)

MasterFormat® 04 41, 04 42, 04 43, 04 43 16, 09 75

Limestone Facades, Cladding & Walls Guide Specs

For spec help, contact us or call 418.692.4695

See LCA, interpretation & rating systems

See materials, interpretation & rating systems

hpd VERSION 2.2

SM Transparency Report (EPD)™ – LEED 4.1 EPD Option 2. Optimization

VERIFICATION	LCA
3rd party reviewed	✔
	Transparency Report (EPD)
3rd party verified	✔

Validity: 2023/01/31 – 2028/01/30
Decl #: POL – 20230131 – 007

This environmental product declaration (EPD) was externally verified, according to ISO 21930:2017, UL PCR Part A, and ISO 14025:2006, by Jack Geibig, President, Ecoform.

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SUMMARY

Reference PCR
ULE PCR Part B: Cladding Product Systems EPD requirements v2.0, 2021

Regions; system boundaries
North America; Cradle to grave

Functional unit / reference service life:
1 m^2 of installed stone cladding; 75 years

LCIA methodology: TRACI 2.1

LCA software; LCI database
SimaPro Developer 9.4
EcoInvent 3.8, US-EI 2.2

LCA conducted by: Sustainable Minds

Public LCA:
Life Cycle Assessment of Natural Stone Cladding for Polycor

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carbon neutral 2025

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LCA results & interpretation

Limestone Facades, Cladding & Walls

Life cycle assessment

Scope and summary

○ Cradle to gate ○ Cradle to gate with options ✔ **Cradle to grave**

Product description

Stone cladding is applied to a building exterior to separate it from the natural environment and provide an outer layer to the building. It not only provides a control to weather elements but also a durable, aesthetically pleasing building appearance. Limestone cladding is used in commercial, residential, and public sector buildings.

The results in this study are presented for cladding with a thickness of 56.77mm.

Functional unit

The functional unit is **one square meter** of installed natural stone cladding for a service life of 75 years. No replacement will be needed during the entire Estimated service life of buildings (ESL). The product system in this study also includes the ancillary materials used in the installation of the product – mortar and masonry connectors. Materials needed to meet functional unit are:

Natural stone - 81.35 kg per m^2
Mortar - 4.88 kg per m^2
Masonry connectors - 0.62 kg per m^2
Water - 1.00 liter per m^2

Detailed information for functional unit properties is shown on Page 4.

Manufacturing data

The data for all limestone stone products were collected from Polycor's limestone quarries and processing facilities covering a period of two years: January 2020 to December 2021. Data for limestone quarry operations were collected from four quarry sites across North America and two quarries from France and grouped as North American limestone quarries and French quarries. Quarries in France are responsible for 5% of the total quarried stone and all the manufacturing facilities are located in North America.

After limestone is extracted from the quarry, it goes to a processing facility. Stone processor operations data were collected from three Polycor limestone processing sites across North America and grouped together as American limestone plants.

- **American limestone plants:** three manufacturing facilities in Indiana.

Data were collected from quarries and producers mainly operating in North America (mainly the US). As such, the geographical coverage for this study is based on North American conditions.

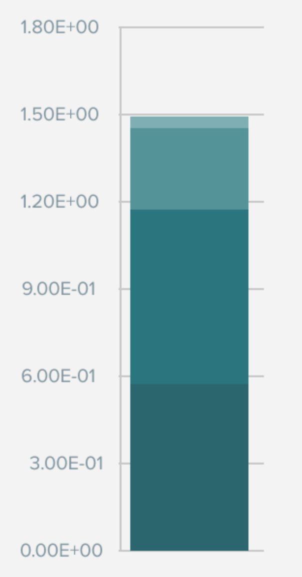
Default installation, packaging, and disposal scenarios

Cladding is delivered at the job site ready for installation, where minor cuts may be necessary to accommodate design. The amount of ancillary materials used depend largely on the building design, but most stone cladding installations incorporate anchors and mortar, used either as masonry bed or to fill veneer cavities. Wood and cardboard used as packaging to safely deliver the stone to the site is then transported to be either landfilled or recycled, following US EPA's end of life scenarios for containers and packaging. At the end of its useful life, the cladding is removed and transported to be either landfilled (31.5%) or recycled (68.5%).

Material composition greater than 1% by weight

MATERIAL	% WEIGHT
Limestone	100%

Total impacts by life cycle stages [mPts/per func unit]

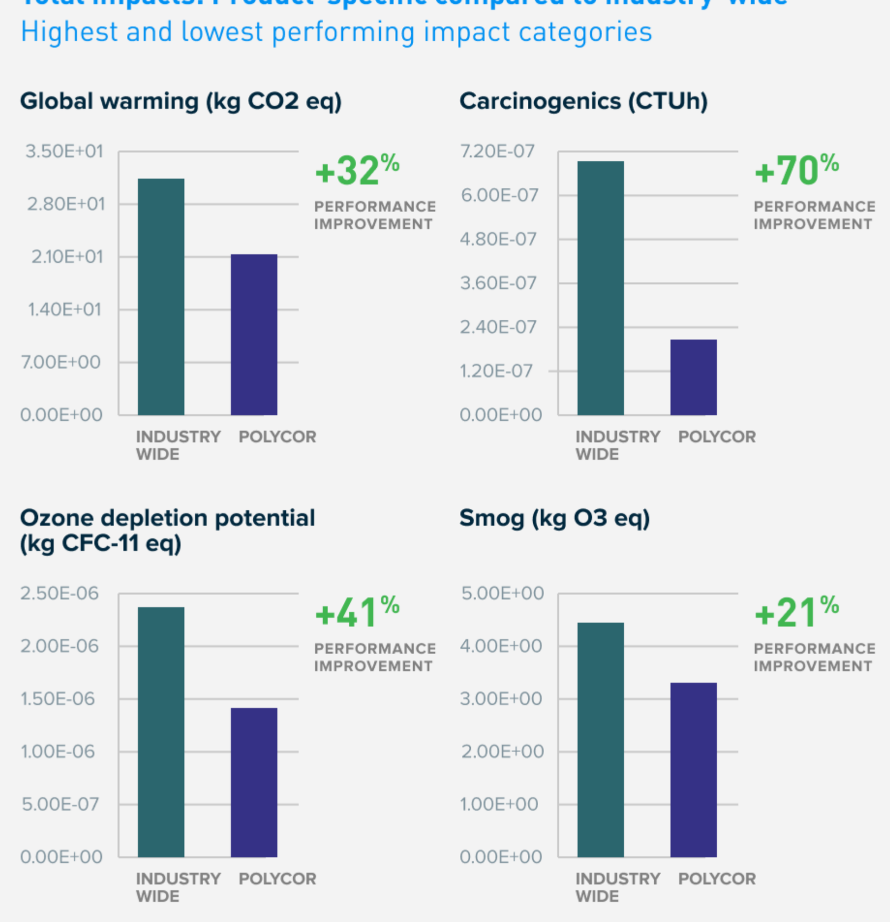


LIFE CYCLE STAGE	MPTS/FUNC. UNIT
Raw material supply and transport	5.72E-01
Manufacturing	6.09E-01
Construction	2.69E-01
End of life	5.37E-02

About NSI industry-wide EPD results

The NSI industry-wide EPD for natural stone cladding serves as a product group benchmark to which product-specific results can be compared. Three impact categories are used for comparison: global warming potential, carcinogenics, and ozone depletion. Global warming potential was selected because its reductions alone can contribute towards satisfying credits under LEED. Carcinogenics and ozone depletion were selected because they had the greatest reduction in impacts aside from global warming potential.

Total impacts: Product-specific compared to industry-wide
Highest and lowest performing impact categories



What's causing the greatest impacts

All life cycle stages

For the natural stone cladding product, the cradle-to-gate stage (A1-A3) dominates the results for all impact categories. This study assessed a multitude of inventory and environmental indicators. In addition to the six major impact categories (global warming potential, ozone depletion, acidification, smog, eutrophication, and fossil fuel depletion), additional impact categories have also been included. 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. LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

Overall results are consistent with expectations for stone cladding's life cycles, with most of the impacts being generated during cradle-to-gate stages, as cladding is not associated with energy consumption during its use stage. Quarry operations (A1) is the highest contributor to five out of the ten impact categories, and processor operations (A3) is the highest contributor for the rest of the five impact categories. The cradle-to-gate stage (A1-A3) contributes to ~80% of the total impacts in all impact categories. The transportation of stone from quarries to processing plants, transportation of cladding from processing plants to the installation sites, and use of mortar during installation also generate significant impacts in the overall life cycle impacts of limestone cladding.

Quarry operations and transport to processors

Impacts generated at limestone quarries (A1) are mainly due to the use of grid electricity and fuels in the quarries. Other material inputs generate little impact in comparison to the electricity and fuel consumed. The transportation of limestone from quarries to processing plants generates insignificant impacts in overall life cycle impacts.

Processor operations and transport to building sites

Manufacturing operations at limestone processing plants make up the greatest impact share for half of the impact categories. Energy consumed at processors (both electricity and fuels) is responsible for the majority of impacts, while other material inputs have an insignificant contribution. The transportation of limestone flooring manufactured in processor plants to the building sites also has a considerable impact on the overall life cycle impacts of limestone flooring.

Other life cycle stages

Cement mortar used during the installation (A5) of limestone cladding also generates significant environmental impacts in the overall life cycle impacts of limestone cladding. Under normal operating conditions, limestone cladding will not require any cleaning. Due to the nature of natural stone, it is anticipated that the stone cladding products will last for the lifetime of the building. The reference service life (RSL) thus meets an ESL of 75 years, and cladding will need no replacements during its service life. The use stage is not relevant since stone cladding does not require any repair, replacement, or refurbishment during its entire service life. End-of-life stages have lower contributions to the total life cycle impacts.

How our product compares to the industry benchmark

Interpretation summary In November 2022, Natural Stone Institute (NSI) published an industry-wide Type III EPD in which Polycor participated. It followed the UL PCR and SM Part B Benchmarking addendum that enables comparison of a product-specific EPD to the industry benchmark. The SM Part B benchmarking addendum requires the selection of the greatest improvement and lowest performing impact categories.

Polycor limestone cladding LCIA results show environmental performance improvements across all impact categories evaluated in this study. The impact reductions primarily stem from A3. Differences in electricity and fuel consumption during fabrication operations contribute significantly when comparing Polycor to industry-average results and identifying the contributors to performance improvement.

The lowest performing impact category (smallest reduction compared to average) is smog. The impacts from transportation to Polycor facilities and during distribution are much lower when comparing Polycor to industry-average results due to lower transportation distances within their supply chain.

Polycor limestone cladding has better environmental performance in these impact categories than the industry average results but does not represent that the Polycor cladding product is better than any specific manufacturer participating in the industry average.

Sensitivity analysis

Based on the recommendation provided by Polycor, impacts for processor operations specific to a square meter of limestone cladding was assumed to match the average stone processing for square meter of limestone. A sensitivity analysis was performed to check the robustness of the results when the energy consumed during processing is varied by +/-20% from the estimate used in this study. The resulting variation in total life cycle impacts of limestone cladding is ~7% for potential CO_2 equivalent emissions and ~8% for fossil fuel depletion. Other impact categories also follow a similar trend.

Natural stone is one of the lowest embodied carbon construction materials. Although we are proud of this intrinsic quality, we want to make sure that we'll never stop improving it. Our main driver is our ambitious 2025 carbon neutrality pledge. By increasing the use of renewable energy, reducing our dependency on fossil fuels, electrifying our car fleet and increasing the energy efficiency throughout our value chain, we aim to reduce our embodied carbon by 40% by the end of 2025!

Beyond embodied carbon, Polycor only uses rainwater for stone extraction, recycles it, and also uses dry sawing technology in a growing number of quarry operations. In quarrying, production, installation and maintenance, natural stone lowers water use throughout its life cycle.

Polycor is the leader within the Natural Stone Sustainability Standard (ANSI 373) with 25% of our sites certified. This standard examines and verifies numerous areas of natural stone production, effectively improving the baseline for the environmental and social performance of natural stone in alignment with green building practices.

See how we make it greener

LCA results

LIFE CYCLE STAGE	RAW MATERIAL SUPPLY AND TRANSPORT	MANUFACTURING	CONSTRUCTION	USE	END OF LIFE
Information modules: Included (X) | Excluded* (MND) Stages B1-B7, C1, and C3 though included, have no associated activities. *Module D is excluded.	**A1 Quarry operations**	**A3 Processor operations**	**A4 Stone transport to building sites**	**B1 Use**	**C1 Deconstruction**
	A2 Transport to processors		**A5 Installation**	**B2 Maintenance**	**C2 Waste Transport**
				B3 Repair	**C3 Waste processing**
				B4 Replacement	**C4 Disposal**
				B5 Refurbishment	
				B6 Operational energy use	
				B7 Operational water use	

SM Single Score

Learn about SM Single Score results

Impacts of 1 square meter of installed natural stone cladding	5.72E-01 mPts	6.09E-01 mPts	2.69E-01 mPts	0 mPts	5.37E-02 mPts
Materials or processes contributing >20% to total impacts in each life cycle stage	Energy consumed during stone quarrying (electricity and fuels).	Energy consumed during stone processing (electricity and fuels).	Truck transportation and use of ancillary materials (mainly mortar) for installation.	N/A	Waste transport to end of life centers.

TRACI v2.1 results per functional unit

LIFE CYCLE STAGE		A1-A2 QUARRY OPERATIONS AND TRANSPORT		A3 PROCESSOR OPERATIONS		A4-A5 STONE TRANSPORT TO BUILDING SITES		B1-B7 USE		C1-C4 END-OF-LIFE	
Ecological damage											
Impact category	Unit	Product	Industry	Product	Industry	Product	Industry	Product	Industry	Product	Industry
Acidification	kg SO_2 eq	5.89E-02	7.48E-02	4.81E-02	6.39E-02	2.30E-02	3.07E-02	0	0	4.37E-03	4.47E-03
Eutrophication	kg N eq	7.27E-03	7.45E-03	5.78E-03	9.05E-03	1.74E-03	2.70E-03	0	0	5.65E-04	5.77E-04
Global warming (Embodied carbon)	kg CO_2 eq	5.92E+00	8.50E+00	7.86E+00	1.29E+01	6.42E+00	8.89E+00	0	0	1.26E+00	1.28E+00
Ozone depletion	kg CFC-11 eq	2.78E-07	5.02E-07	3.60E-07	6.21E-07	5.05E-07	9.97E-07	0	0	2.49E-07	2.54E-07
Human health damage											
Impact category	Unit	Product	Industry	Product	Industry	Product	Industry	Product	Industry	Product	Industry
Carcinogenics	CTU_h	8.96E-08	2.10E-07	8.74E-08	4.56E-07	2.75E-08	2.86E-08	0	0	5.14E-10	5.25E-10
Non-carcinogenics	CTU_h	6.10E-07	8.73E-07	6.34E-07	1.06E-06	3.96E-07	4.88E-07	0	0	4.55E-08	4.65E-08
Respiratory effects	kg $PM_{2.5}$ eq	3.71E-03	6.51E-03	1.16E-02	1.64E-02	1.85E-03	2.34E-03	0	0	3.18E-04	3.25E-04
Smog	kg O_3 eq	1.71E+00	2.20E+00	1.23E+00	1.47E+00	4.05E-01	6.08E-01	0	0	1.17E-01	1.20E-01
Additional environmental information											
Impact category	Unit	Product	Industry	Product	Industry	Product	Industry	Product	Industry	Product	Industry
Fossil fuel depletion	MJ, LHV	1.08E+01	1.57E+01	1.38E+01	1.72E+01	6.91E+00	1.19E+01	0	0	2.56E+00	2.62E+00
Ecotoxicity	CTU_e	49.4 %	46.5 %	38.6 %	41.4 %	9.0 %	10.1 %	0 %	0 %	3.0 %	2.0 %

See the additional content required by the ULE PCR Part B for cladding product systems on page 4 of the **Transparency Report PDF**.

References

LCA Background Report
Polycor Natural Stone Cladding LCA Background Report (public version), Polycor 2023. SimaPro Analyst 9.4, ecoinvent 3.4 database.

PCRs

ISO 21930:2017 serves as the core PCR along UL Part A.

ULE PCR Part A: Life Cycle Assessment Calculation Rules and Report Requirements v3.2
December, 2018. Technical Advisory Panel members reviewed and provided feedback on content written by UL Environment and USGBC. Past and present members of the Technical Advisory Panel are listed in the PCR.

ULE PCR Part B: Cladding Product Systems EPD requirements v2.0
April 2021. PCR review conducted by: Jim Mellentine (Thrive ESG); Christopher White (NIST), Ph.D.; and Philip S. Moser, P.E.(MA) (Simpson Gumpertz & Heger).

UL Environment General Program Instructions v2.5, March 2021 (available upon request)

ISO 14025, "Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services"

Download PDF SM Transparency Report, which includes the additional EPD content required by the UL Environment PCR.

SM Transparency Reports (TR) are ISO 14025 Type III environmental declarations (EPD) that enable purchasers and users to compare the potential environmental performance of products on a life cycle basis. Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance of Cladding Product Systems 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. Full conformance with the PCR for stone cladding allows EPD comparability only when all stages of a life cycle have been considered, when they comply with all referenced standards, use the same sub-category PCR, and use equivalent scenarios with respect to construction works. However, variations and deviations are possible.
Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared

Rating systems

The intent is to reward project teams for selecting products from manufacturers who have verified improved life-cycle environmental performance.

LEED BD+C: New Construction | v4 - LEED v4
Building product disclosure and optimization
Environmental product declarations
Option 1: Environmental Product Declaration

- ○ Industry-wide (generic) EPD — ½ product
- ✔ Product-specific Type III EPD — 1 product

Option 2: Multi-attribute optimization

- ✔ Product-specific Type III EPD

LEED BD+C: New Construction | v4.1 - LEED v4.1
Building product disclosure and optimization
Environmental product declarations
Option 1: Environmental Product Declaration

- ○ Industry-wide (generic) EPD — 1 product
- ✔ Product-specific Type III EPD — 1.5 products

Option 2. Embodied Carbon/LCA Optimization
The comparative analysis must show impact reduction(s) of at least 20% in the global warming potential (GWP) impact category and at least 5% reduction in two additional impact categories relative to baseline and includes a narrative describing how the impact reductions were achieved.

- ✔ Product-specific Type III EPD — 2 products

BREEAM New Construction 2018
Mat 02 - Environmental impacts from construction products
Environmental Product Declarations (EPD)

- Industry average EPD — .5 points
- Multi-product specific EPD — .75 points
- ✔ Product-specific EPD — 1 point

SM Transparency Report (EPD)™ – LEED 4.1 EPD Option 2. Optimization

VERIFICATION	LCA
3rd party reviewed	✔
Transparency Report (EPD)	
3rd party verified	✔

Validity: 2023/01/31 – 2028/01/30
Decl #: POL – 20230131 – 007

This environmental product declaration (EPD) was externally verified, according to ISO 21930:2017, UL Part A, and ISO 14025:2006, by Jack Geibig, President, Ecoform.

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SUMMARY
Reference PCR
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North America; Cradle to grave
Functional unit / reference service life:
1 m^2 of installed stone cladding; 75 years
LCIA methodology: TRACI 2.1
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Contact us

How we make it greener

Limestone Facades, Cladding & Walls

Collapse all

See LCA results by life cycle stage

RAW MATERIALS ACQUISITION

Natural stone quarrying process has high yields and little excess material because the stone is close to surface. It's different from metal mining, where large amounts of earth must be removed to extract very little quantities. Also, underground quarrying, which has been perfected for generations at our Eureka Quarry, reduces land use and is a practice that Polycor wishes to extend to several quarries.

In addition, few consumables are needed to extract natural stone. Contrast that with other building materials, Polycor specifically focuses on sourcing the highest grades of natural stone so that, for instance, a black granite stone, doesn't need dyes to achieve its rich color.

From the bedrock to the point of sale, Polycor maintains an unbroken ownership of the supply chain allowing it to maintain standards of quality and practice.

TRANSPORTATION

Using stone from local sources is the single biggest opportunity to reduce its embodied carbon. Since natural stone is a heavy material, the environmental impacts for transporting it end up being one of its most significant source of carbon. Natural stone is sourced world-wide and each deposit has unique aesthetic and performance characteristics so this is not always avoidable. Be sure to understand the distances between the quarry, the processing facility, sometimes the distribution centers but also the transportation mode. In most of Polycor's operations, the quarry is within miles of the processing facility.

MANUFACTURING

Manufacturing natural stone is so simple that you can sumarize it by a single action, cutting. Cutting large piece into smaller pieces ending in a finished product. Also, the beauty of natural stone products is that there is no chemical mixed within our products. Therefore, they are inherently a non-emitting source of VOCs.

Recycling water is reused several times into the manufacturing process and is compulsory to achieve ANSI 373 Standard.

There are a large variety of sizes and finishes that are commonly used for natural stone. Design teams can help reducing energy consumption in the following ways: Usage of low embodied carbon finishes such as water jet, 3D analysis to loose as few stone as possible troughout it's transformation, accepting the natural variation in the material so there is more usable material.

OTHER (USE, END OF LIFE)

Whether you think of the Egyptian pyramids, the Colosseum of Rome, the cathedrals of the European capitals or closer to us; the famous Empire State building; natural stone is the most durable, classic and timeless building material on Earth. With 100+ years of durability, natural stone lasts longer than other building construction material and projects that use natural stone require less maintenance.

Since we don't use any chemicals, natural stone products as well as excess process materials throughout the extraction and transformation phases can be reused or recycled into gravel for roads, landscaping products and even furniture and jewelry. In short, natural stone can be reused and recycled multiple times during its life cycle; the only limit is your imagination!

Nevertheless, even if natural stone ends up in a construction landfill, there will be no toxic chemicals seeping into the earth as the material degrades. It simply returns to the earth, cradle to cradle.

SM Transparency Report (EPD)™ – LEED 4.1 EPD Option 2. Optimization

VERIFICATION	LCA
3rd party reviewed	✓
	Transparency Report (EPD)
3rd party verified	✓

Validity: 2023/01/31 – 2028/01/30

Decl #: POL – 20230131 – 007

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carbon neutral 2025

Contact us

Additional EPD content required by:
ULE PCR Part B: Cladding Product Systems EPD Requirements

Limestone Cladding

Data

Background This product-specific declaration was created by collecting product data for one square meter (m^2) of installed limestone cladding. Limestone cladding is the installation of exterior cladding to a building that separates it from the natural environment and provides an outer layer to the building. Material and production inputs from each quarry and processor site were used to calculate weighted averages of those inputs based on the production share of the site.

Allocation The allocation methods used were examined according to the updated allocation rules in ISO 21930:2017. Quarry inputs and outputs were divided evenly among the quarried limestone by mass, and no co-product allocation was needed. Similarly, no co-product allocation was required for processor operations as well since processing data was collected from Polycor's processing plants specific to limestone. The processor inputs and outputs were divided evenly among the processed stone by area.

Cut-off criteria for the inclusion of mass and energy flows are 1% of renewable primary resource (energy) usage, 1% nonrenewable primary resource (energy) usage, 1% of the total mass input of that unit process, and 1% of environmental impacts. The total of neglected input flows per module does not exceed 5% of energy usage, mass, and environmental impacts. No known flows are deliberately excluded from this declaration. Biogenic carbon is included in reported results.

Quality Primary data was collected for a time period of two years, which represents typical operations of Polycor's limestone quarry and processors across North America. Inventory data is considered to have a good precision and provide a representative depiction of the industry average. Data is also considered to be complete as no know flows are deliberately excluded from this analysis other than those defined to be outside of the system boundary. Proxy and generic datasets have been used for some materials and processes, but are considered to be sufficiently representative.

Quarry and Manufacturing Plant information

Data Group	Quarry location(s)
North American Limestone Quarries	Adams Quarry, Bloomington, IN Empire Quarry, Oolitic, IN Eureka Quarry, Bedford, IN Victor Quarry, Bloomington, IN
French Limestone Quarries (5% of the total quarried stone)	Massangis Quarry, Massangis, France Rocherons Quarry, Corgoloin et Comblanchien, France
Data Group	**Manufacturing Plant location(s)**
North American Limestone Plants	Empire Plant, Oolitic, IN Eureka Plant, Bedford, IN Victor Plant, Bloomington, IN

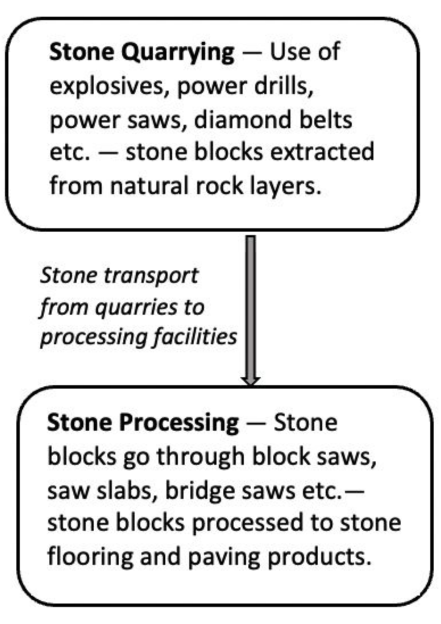
Functional unit properties

Parameter	Unit	Test Method	Value
CSI Masterformat classification	04 42 00		
Stone type	Limestone		
Stone grades	All grades		
Product weight	kg		81.35
Thickness to achieve functional unit	m		0.05677
Density	kg/m^3		2,307
Length	m		1.52
Width	m		0.66
Flexural strength	Mpa	C880	3.45
Modulus of rupture	MPa	C99	2.76
Thermal conductivity (k-value)	W/mK	ASTM C518	1.26
Thermal resistance (R-value)	m.K/W	ASTM C518	0.79
Compressive strength	MPa	C170	12.41
Water vapor permeance	metric perms	Not relevant	
Liquid water absorption	% of dry wt	C97	10-15
Airborne sound reduction	dB	Not relevant	
Sound absorption coefficient	%	Not relevant	

Calcination CO_2 emissions

Although calcination and carbonation is not relevant to limestone cladding products, calcination occurs during installation stage due to the use of mortar. Mortar includes cement calcination CO_2 emissions which is calculated & reported separately using a carbon intensity factor of 886 CO_2 per ton of cement (Source: U.S. Cement Industry Carbon Intensities (2019)).

Production flow chart



Scenarios and additional technical information

Transport from Quarry to Processor (A2)

Based on the primary data, the transport distance between Polycor's limestone quarry and processing facilities varies, & the weighted distance is 36 km. For the quarries who had no primary information, a conservative stone transportation distance of 100 km via truck & trailer was assumed.

Transport to the building site (A4)

Parameter	Value	Unit
Vehicle type	Lorry, 16-32 ton	
Fuel type	Diesel	
Liters of fuel	0.41	l/100 km
Distance from manufacturer to installation site	100	km (weighted avg)
Capacity utilization (mass based)	100	%
Gross density of products transported	2,307	kg/m^3
Capacity utilization volume factor	1	

Installation into the building (A5)

Even though cladding fabrication (cutting and finishing to required size) is done at the processing plants and is typically delivered to the job site ready for installation, minor changes may be necessary to accommodate design revisions. For consistency with the industry-average LCA an installation scrap rate of 5% is assumed.

Installation scrap assumed	5	%
Ancillary materials - Mortar Masonry connectors	4.88 0.62	kg
Net freshwater consumption	1	L
Electricity consumption	0	kWh
Product loss per functional unit (scrap)	4.07	kg
Waste materials at the construction site before waste processing (stone scrap and packaging waste)	7.47	kg
Output materials resulting from on-site waste processing	0	kg
Mass of packaging waste specified by type Cardboard Wood	0 2.53	kg
Biogenic carbon contained in packaging	4.64	kg CO_2
Direct emissions to ambient air, soil and water	0	kg
VOC emissions	0	µg/m^3

Maintenance scenario parameters (B1-B7)

Maintenance process information	Cleaning the surface of limestone cladding
Maintenance cycle	None
Maintenance process information	None
Energy input during maintenance	Not necessary

Reference service life information

Reference Service Life (RSL)	75	years
Estimated Service life (ESL)	75	years
Design application parameters	Outdoor applications	
Outdoor environment	Installation as recommended by manufacturer.	
Indoor environment	Not relevant	
Use conditions	All conditions	

End of life (C1-C4)

Assumptions for scenario development	The product is dismantled and removed from the building manually. It is transported to a local facility where it requires no further processing before final disposition.		
Collection process	Collected separately	0	kg
	Collected with mixed construction waste	86.85	kg
Disposal	Landfill (31.5%)	27.38	kg
Recovery	Reuse	0	kg
	Recycling (68.5%)	59.47	kg
Waste transport		100	km
Removals of biogenic carbon (excluding packaging)		0	kg CO_2

Hazardous waste

Polycor's limestone cladding do not contain substances that are identified as hazardous according to the Resource Conservation and Recovery Act (RCRA), Subtitle C.

Major system boundary exclusions

- Capital goods and infrastructure,
- Maintenance and operation of support equipment;
- Manufacture and transport of packaging materials not associated with final product;
- Human labor and employee transport;
- Building operational energy and water use not associated with final product.

Major assumptions and limitations

- Quarrying & processing inventory specific to cladding are generated using the production share of cladding by stone types among the participant processors only.
- Energy consumed for cladding stone processing is assumed to be similar to the average energy processing of all stone products.
- Gaps in materials data for participant manufacturers are filled with an average from other facilities.
- A conservative stone transport distance of 100 km is taken for stone transport from quarries to processors for the quarries with no primary transport info.

LCIA results, resource use, output & waste flows, and carbon emissions & removals per m^2 of limestone cladding

LCIA results (per m^2 of limestone cladding)

Parameter	Unit	A1	A2	A3	A4	A5	B1-B7	C2	C4	Total
Ozone depletion	kg CFC-11 eq	1.42E-07	1.36E-07	3.60E-07	3.86E-07	1.19E-07	0	2.37E-07	1.15E-08	**1.39E-06**
Global warming	kg CO_2 eq	5.24E+00	6.81E-01	7.86E+00	1.93E+00	4.49E+00	0	1.19E+00	6.72E-02	**2.15E+01**
Smog	kg O_3 eq	1.65E+00	5.60E-02	1.23E+00	1.59E-01	2.46E-01	0	9.79E-02	1.95E-02	**3.46E+00**
Acidification	kg SO_2 eq	5.68E-02	2.13E-03	4.81E-02	6.06E-03	1.69E-02	0	3.72E-03	6.49E-04	**1.34E-01**
Eutrophication	kg N eq	6.98E-03	2.87E-04	5.78E-03	8.15E-04	9.24E-04	0	5.01E-04	6.35E-05	**1.54E-02**
Carcinogenics	CTUh	8.93E-08	2.83E-10	8.74E-08	8.04E-10	2.67E-08	0	4.94E-10	1.97E-11	**2.05E-07**
Non-carcinogenics	CTUh	5.84E-07	2.56E-08	6.34E-07	7.26E-08	3.23E-07	0	4.47E-08	7.79E-10	**1.68E-06**
Respiratory effects	kg $PM_{2.5}$ eq	3.58E-03	1.34E-04	1.16E-02	3.80E-04	1.47E-03	0	2.34E-04	8.42E-05	**1.75E-02**
Ecotoxicity	CTUe	1.05E+01	3.71E-01	8.49E+00	1.05E+00	9.28E-01	0	6.48E-01	6.39E-03	**2.20E+01**
Fossil fuel depletion	MJ surplus	9.37E+00	1.39E+00	1.38E+01	3.94E+00	2.97E+00	0	2.42E+00	1.42E-01	**3.40E+01**

Energy consumption, energy type, and material resources (per m^2 of limestone cladding)

Parameter	Unit	A1	A2	A3	A4	A5	B1-B7	C2	C4	Total
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	1.94E+00	3.88E-01	1.11E+01	4.03E-02	1.96E+00	0	2.48E-02	1.94E-03	**1.55E+01**
Renewable primary resources with energy content used as material	MJ, LHV	7.54E-01	0	1.71E+01	0	0	0	0	0	**1.78E+01**
Total use of renewable primary resources with energy content	MJ, LHV	2.70E+00	3.88E-01	2.82E+01	4.03E-02	1.96E+00	0	2.48E-02	1.94E-03	**3.33E+01**
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	7.69E+01	7.13E+01	1.43E+02	2.59E+01	4.18E+01	0	1.59E+01	9.43E-01	**3.75E+02**
Non-renewable primary resources with energy content used as material	MJ, LHV	3.09E-01	0	4.60E-03	0	0	0	0	0	**3.14E-01**
Total use of non-renewable primary resources with energy content	MJ, LHV	7.72E+01	7.13E+01	1.43E+02	2.59E+01	4.18E+01	0	1.59E+01	9.43E-01	**3.76E+02**
Secondary materials	kg	0	0	0	0	0	0	0	0	**0**
Renewable secondary fuels	MJ, LHV	0	0	0	0	0	0	0	0	**0**
Non-renewable secondary fuels	MJ, LHV	0	0	0	0	0	0	0	0	**0**
Recovered energy	MJ, LHV	0	0	0	0	0	0	0	0	**0**
Use of net freshwater resources	m^3	9.08E+00	4.79E-02	3.47E+00	1.36E-01	3.12E+00	0	8.37E-02	6.50E-03	**1.59E+01**

Output flows and waste category indicators (per m^2 of limestone cladding)

Parameter	Unit	A1	A2	A3	A4	A5	B1-B7	C2	C4	Total
Hazardous waste disposed	kg	1.86E-02	0	0.00E+00	0	0	0	0	0	**1.86E-02**
Non-hazardous waste disposed	kg	3.42E-02	0	7.42E-02	0	2.49E+00	0	0	2.74E+01	**3.00E+01**
High-level radioactive waste, conditioned, to final repository	kg	2.41E-03	7.42E-07	7.79E-03	2.11E-06	3.17E-04	0	1.30E-06	1.01E-07	**1.05E-02**
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	5.72E-09	7.79E-09	4.15E-05	2.21E-08	6.48E-07	0	1.36E-08	1.06E-09	**4.22E-05**
Components for re-use	kg	0	0	0	0	0	0	0	0	**0**
Materials for recycling	kg	2.07E+02	0	0.00E+00	0	4.98E+00	0	0	5.95E+01	**2.71E+02**
Materials for energy recovery	kg	0	0	0	0	0	0	0	0	**0**
Exported energy (EE)	MJ, LHV	0	0	0	0	0	0	0	0	**0**

Carbon emissions and removals (per m^2 of limestone cladding)

Parameter	Unit	A1	A2	A3	A4	A5	B1-B7	C2	C4	Total
Biogenic Carbon Removal from Product	kg CO_2	0	0	0	0	0	0	0	0	**0**
Biogenic Carbon Emission from Product	kg CO_2	0	0	0	0	0	0	0	0	**0**
Biogenic Carbon Removal from Packaging	kg CO_2	0	0	4.65E+00	0	2.32E-01	0	0	0	**4.88E+00**
Biogenic Carbon Emission from Packaging	kg CO_2	0	0	0	0	3.53E+00	0	0	0	**3.53E+00**
Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes	kg CO_2	0	0	0	0	0	0	0	0	**0**
Calcination Carbon Emissions	kg CO_2	0	0	0	0	1.21E+00	0	0	0	**1.21E+00**
Carbonation Carbon Removals	kg CO_2	0	0	0	0	0	0	0	0	**0**
Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes	kg CO_2	0	0	0	0	0	0	0	0	**0**