

This Environmental Product Declaration (EPD) reports the impacts for 1 m³ of concrete formed into manufactured concrete and masonry products meeting the following specifications:

- ASTM C90, Concrete Masonry Unit, Load-Bearing

PRODUCT DESCRIPTION

Lightweight Concrete Masonry Units:

Angelus Lightweight CMU are made with ASTM C595 Portland Limestone Cement Type IL, and ASTM C33 and C331 aggregates. Available in 4, 6, and 8-inch heights, and widths from veneers to 16-inch wide structural. Dimensional properties as defined in ASTM C90.



PROGRAM OPERATOR

ASTM International

100 Barr Harbor Drive
West Conshohocken, PA 19428



DATE OF ISSUE

08/09/2023 (valid for 5 years until 08/09/2028)

ENVIRONMENTAL IMPACTS

Declared Product:

CMU: LW • Sun Valley Plant
Density Factor: 1650 kg / m³
Compressive strength: 14 MPa

Declared Unit: 1 m³ of concrete formed into manufactured concrete masonry product (CMU)

| | |
|---|---------|
| Global Warming Potential (kg CO ₂ -eq) | 215 |
| Acidification Potential (kg SO ₂ -eq) | 0.74 |
| Eutrophication Potential (kg N-eq) | 0.16 |
| Smog Creation Potential (kg O ₃ -eq) | 17.0 |
| Ozone Depletion Potential (kg CFC-11-eq) | 3.11E-6 |

Material Composition: Aggregate (natural), Cinder, Portland Limestone Cement, Batch water

Additional detail and impacts are reported on page five of this EPD



| | |
|---|---|
| General Program Instructions | ASTM Program Operator for Product Category Rules (PCRs) and Environmental Product Declarations (EPDs), General Program Instructions. Version 8.0, revised April 29, 2020. |
| Reference PCR | Part B: Concrete Masonry and Segmental Concrete Paving Product EPD Requirements, November 11 2020. V1.0 |
| The sub-category PCR review was conducted by: | Jack Geibig, Ecoform, LLC, Terrie Boguski, Harmony Environmental, LLC, Christine Subasic, P.E., LEED AP, Consulting Architectural Engineer |
| Product RSL | n/a |
| Markets of Applicability | North America |
| EPD Type | Product Specific |
| Declared Unit | One cubic meter (m3) of concrete formed into manufactured concrete products |
| Dataset Variability | n/a |
| EPD Scope | Cradle to Gate |
| Year(s) of Reported Manufacturer Primary Data | - |
| LCA Software | CarbonCLARITY Suite, Concrete Block EPD Generator ■ Verification |
| LCI Database(s) | Ecoinvent, USLCI, US-EI |
| LCIA Methodology | TRACI 2.1 v1.04 |
| This declaration was independently verified in accordance with ISO 14025:2006. The UL Environment “Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report,” v3.2 (December 2018), in conformance with ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL environment Part A Enhancement (2017). <input type="checkbox"/> internal <input checked="" type="checkbox"/> external | Thomas P. Gloria (t.gloria@industrial-ecology.com) Industrial Ecology Consultants |
| This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by: | Climate Earth (support@climateearth.com) |
| This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by: | Thomas P. Gloria (t.gloria@industrial-ecology.com) Industrial Ecology Consultants |

Limitations

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.

LIFE CYCLE ASSESSMENT

SYSTEM BOUNDARY

This EPD is a cradle-to-gate EPD covering the product stages (A1-A3) only

| PRODUCTION Stage <i>(Mandatory)</i> | | | CONSTRUCTION Stage | | USE Stage | | | | | END-OF-LIFE Stage | | | |
|--|----------------------|---------------|--------------------|--------------|-----------|-------------|--------|-------------|---------------|--------------------------------|---|------------------|-------------------|
| Extraction and upstream production | Transport to factory | Manufacturing | Transport to site | Installation | Use | Maintenance | Repair | Replacement | Refurbishment | De-construction/ Demolition | Transport to waste processing or disposal | Waste processing | Disposal of waste |
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | C1 | C2 | C3 | C4 |
| X | X | X | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND |

Note: MND = module not declared; x = module included.

The production stages and primary unit processes included in the study by product stage are:



Relevant Information for product stages not included in system boundary (A4-C4):

Other products not included in assessment needed for the product to serve intended function in the construction work can include mortar, grout, and reinforcement for concrete masonry product;

Product packaging waste per declared unit include: 31.78 kg pallet waste, 0.07 kg stretch wrap waste, 0 kg foam waste;

Typical end of life treatment is unknown but can include landfill or crushing and then re-use as a recycled aggregate or as road base; The reference service life for concrete masonry is 75 years and for segmental concrete paving is 50 years.

CUT-OFF

Items excluded from system boundary include: production, manufacture, and construction of manufacturing capital goods and infrastructure; production and manufacture of production equipment, delivery vehicles, and laboratory equipment; personnel-related activities (travel, furniture, and office supplies); 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. No known flows were deliberately excluded from this EPD.

ALLOCATION PROCEDURE

Allocation follows the requirements and guidance Part A: Life Cycle Assessment Calculation Rules and Report Requirements, section 3.3.

The product category rules for this EPD recognize fly ash, silica fume and slag as waste products recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a concrete material input.

PRIMARY SOURCES OF LCI DATA

- **Aggregate (natural):** US-EI (2020): "Gravel, round, at mine/US", 2001
- **Cleaning Chemicals:** Ecoinvent 3.4: 50% Citric acid and 50% Phosphoric acid, industrial grade, without water, in 70% solution state, market for/GLO, 2017
- **Diesel:** USLCI (2015): "Diesel, combusted in industrial equipment/NREL/US", 2007
- **Electricity (WECC):** Ecoinvent 3.4: "Electricity, medium voltage, market for, cut-off", 2015
- **Municipal Water:** US-EI (2020): "Tap water, at user/US", 2000
- **Natural gas:** USLCI (2015): "Natural gas, combusted in industrial boiler/NREL/US", 2007
- **Non-Hazardous Solid Waste:** US-EI (2016): Disposal, municipal solid waste, 2008
- **Oils, Lubricants and Greases:** Ecoinvent 3.5: Lubricating oil, GLO, market for, cut-off, 2011
- **Portland-limestone Cement:** Supplier specific primary data, 2020
- **Propane:** USLCI (2015): "Liquefied petroleum gas, at refinery/NREL/US, 2007
- **Pumice:** US-EI (2020): "Pumice, at mine/US, 2010
- **Truck transport:** USLCI (2015): "Transport, combination truck, short-haul, diesel powered/tkm/RNA", 2010

INTERPRETATION

The material extraction (A1) product stage dominates most of the potential environmental impacts with cement contributing the greatest percentage of impacts in this stage. This EPD was calculated using manufacturer specific cement data that represents 100% of the total cement used in this mix.

Life cycle impact assessment (LCIA) results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks (ISO 14044, ISO 14040). EPDs are comparable only if they comply with ISO 21930 (2017), use the same, sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

DECLARATION OF ENVIRONMENTAL INDICATORS DERIVED FROM LCA

| Impact Assessment | Unit | A1 | A2 | A3 | Total |
|--|------------------------|----------|----------|----------|----------|
| Global warming potential | kg CO ₂ -eq | 1.54E+02 | 2.48E+01 | 3.62E+01 | 2.15E+02 |
| Depletion potential of the stratospheric ozone layer (ODP) | kg CFC-11-eq | 1.42E-06 | 1.05E-09 | 1.69E-06 | 3.11E-06 |
| Eutrophication potential | kg N-eq | 2.65E-02 | 1.74E-02 | 1.19E-01 | 1.63E-01 |
| Acidification potential of soil and water sources (AP) | kg SO ₂ -eq | 2.37E-01 | 2.91E-01 | 2.1E-01 | 7.38E-01 |
| Formation potential of tropospheric ozone (POCP) | kg O ₃ -eq | 6.72E+00 | 7.35E+00 | 2.89E+00 | 1.7E+01 |

Resource Use

| | | | | | |
|--|----------------|----------|----------|----------|----------|
| Abiotic depletion potential for non-fossil mineral resources (ADP _{elements})* | kg Sb-eq | 5.47E-05 | - | 7.15E-06 | 6.18E-05 |
| Abiotic depletion potential for fossil resources (ADP _{fossil}) | MJ | 8.73E+02 | 3.56E+02 | 5.5E+02 | 1.78E+03 |
| Renewable primary energy resources as energy (fuel), (RPRE)* | MJ | 3.34E+01 | 0E+00 | 7.29E+02 | 7.62E+02 |
| Renewable primary resources as material, (RPRM)* | MJ | 0E+00 | - | 0E+00 | 0E+00 |
| Non-renewable primary resources as energy (fuel), (NRPRE)* | MJ | 9.23E+02 | 3.56E+02 | 5.99E+02 | 1.88E+03 |
| Non-renewable primary resources as material (NRPRM)* | MJ | 0E+00 | - | 0E+00 | 0E+00 |
| Consumption of fresh water | m ³ | 1.71E+00 | - | 3.87E-01 | 2.09E+00 |

Secondary Material, Fuel and Recovered Energy

| | | | | | |
|---------------------------------------|----|-------|---|-------|-------|
| Secondary Materials, (SM)* | kg | 0E+00 | - | 0E+00 | 0E+00 |
| Renewable secondary fuels, (RSF)* | MJ | 0E+00 | - | 0E+00 | 0E+00 |
| Non-renewable secondary fuels (NRSF)* | MJ | 0E+00 | - | 0E+00 | 0E+00 |
| Recovered energy, (RE)* | MJ | 0E+00 | - | 0E+00 | 0E+00 |

Waste & Output Flows

| | | | | | |
|--|----------------|----------|---|----------|----------|
| Hazardous waste disposed* | kg | 8.54E-03 | - | 0E+00 | 8.54E-03 |
| Non-hazardous waste disposed* | kg | 8.41E-02 | - | 7.53E-01 | 8.37E-01 |
| High-level radioactive waste* | m ³ | 5.63E-09 | - | 2.48E-08 | 3.04E-08 |
| Intermediate and low-level radioactive waste* | m ³ | 2.71E-08 | - | 2.18E-07 | 2.45E-07 |
| Components for reuse* | kg | - | - | 0E+00 | 0E+00 |
| Materials for recycling* | kg | 0E+00 | - | 2.93E-01 | 2.93E-01 |
| Materials for energy recovery* | kg | 0E+00 | - | 4.75E-02 | 4.75E-02 |
| Recovered energy exported from the product system* | MJ | 0E+00 | - | 0E+00 | 0E+00 |

Additional Inventory Parameters for Transparency

| | | | | | |
|---|------------------------|----------|-------|-------|----------|
| Emissions from calcination and uptake from carbonation* | kg CO ₂ -eq | 7.84E+01 | 0E+00 | 0E+00 | 7.84E+01 |
|---|------------------------|----------|-------|-------|----------|

* Emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in these categories.

- Not all LCA datasets for upstream materials include these impact categories and thus results may be incomplete. Use caution when interpreting data in these categories.

No substances required to be reported as hazardous are associated with the production of this product.

REFERENCES

- ISO 14025: 2006 – Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- ISO 14040: 2006 – Environmental management – Life cycle assessment – Principles and framework
- ISO 14044: 2006/Amd 2:2020 – 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
- Part A: Life Cycle Assessment Calculation Rules and Report Requirements UL Environment (December 2018, version 3.2)
- Part B: Concrete Masonry and Segmental Concrete Paving Product EPD Requirements UL Environment (November 2020, v1.0)