Environmental Product Declaration (EPD) for Cement Produced at Union Bridge Cement Plant

GENERAL INFORMATION
This cradle to gate Environmental Product Declaration covers four cement products produced at the Union Bridge Cement Plant. The Life Cycle Assessment (LCA) was prepared in conformity with ISO 21930, ISO 14025, ISO 14040, and ISO 14044. This EPD is intended for business-to-business (B-to-B) audiences.

LEHIGH CEMENT
Union Bridge Cement Plant and Terminal
675 Quaker Hill Road
Union Bridge, MD 21791

PROGRAM OPERATOR
National Ready Mixed Concrete Association
900 Spring Street
Silver Spring, MD 20910
https://www.nrmca.org/
NRMCAEPD: 20041

DATE OF ISSUE
May 1, 2021 (valid for 5 years until May 1, 2026)

ENVIRONMENTAL IMPACTS
Lehigh Union Bridge Plant: Product-Specific Type III EPD
Declared Cement Products (four):
Type II; Type I/II; Type III; Masonry
Declared Unit: One metric tonne of cement

Global Warming Potential (kg CO₂-eq)

<table>
<thead>
<tr>
<th>CEMENT PRODUCTS</th>
<th>Type II</th>
<th>Type III</th>
<th>Type I/II</th>
<th>Masonry</th>
</tr>
</thead>
<tbody>
<tr>
<td>801</td>
<td>856</td>
<td>877</td>
<td>492</td>
<td></td>
</tr>
</tbody>
</table>

- Ozone Depletion Potential (kg CFC-11-eq)
  - Type II: 6.4E-06
  - Type III: 5.92E-06
  - Type I/II: 6.80E-05
  - Masonry: 4.99E-06

- Eutrophication Potential (kg N-eq)
  - Type II: 1.26
  - Type III: 1.32
  - Type I/II: 1.37
  - Masonry: 0.79

- Acidification Potential (kg SO₂-eq)
  - Type II: 1.26
  - Type III: 1.26
  - Type I/II: 1.36
  - Masonry: 0.96

- Photochemical Ozone Creation Potential (kg O₃-eq)
  - Type II: 30.1
  - Type III: 32.0
  - Type I/II: 32.8
  - Masonry: 18.9

- Abiotic Depletion, nonfossil (kg Sr-eq)
  - Type II: 5.44E-06
  - Type III: 5.23E-06
  - Type I/II: 5.69E-06
  - Masonry: 4.58E-06

- Abiotic Depletion, fossil (MJ)
  - Type II: 3.802
  - Type III: 3.912
  - Type I/II: 4.142
  - Masonry: 2.540

Product Components:
- Clinker: 82% 90% 91% 48%
- Limestone, Gypsum and Others: 19% 10% 9% 52%

Additional detail and impacts are reported on page 5

ISO 21930:2017 Sustainability in Building Construction-Environmental Declaration of Building Products: serves as the core PCR
NSF PCR for Portland, Blended, Masonry, Mortar, and Plastic (Stucco) Cements V2: serves as the sub-category PCR

Sub-category PCR review was conducted by
Thomas P. Gloria, PhD. (t.gloria@industrial-ecology.com) • Industrial Ecology Consultants

Independent verification of the declaration, according to ISO 21930:2017 and ISO 14025:2006: ☐ internal ☑ external

Third party verifier Thomas P. Gloria, PhD. (t.gloria@industrial-ecology.com) • Industrial Ecology Consultants

For additional explanatory material
 Manufacture Representative: Jeff Hook (jeff.hook@lehighhanson.com)
This LCA EPD was prepared by: Laurel McEwen, VP EPD Services • Climate Earth (www.climateearth.com)

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.
Lehigh Cement, a leading supplier of cementitious construction materials in North America, has been manufacturing cement in Maryland for more than 100 years, making us a pillar of the many communities around us and providing employment and economic benefit to small towns and cities. We now operate one cement plant in Union Bridge, a rural town in western Carroll County which went through a modernization phase in 2001. This modernization improved the environmental impacts through efficient and more sustainable production of clinker and cement. Lehigh Cement’s commitment to sustainable construction includes actively working to create lower carbon cements through supplementary cementitious materials (SCMs) and alternative raw materials and fuels. Consistent with Heidelberg Cement’s vision of reducing greenhouse gas (GHG) emissions to have carbon neutral concrete by 2050, Lehigh has developed product and plant specific EPDs as baselines for its embodied carbon.

The health and well-being of our employees, communities and the natural environment are vital to our success, so we work hard to give back to surrounding areas. We also maintain a constant communication with local governments and councils to preserve a neighborly relationship, which we take very seriously. Through donations and participation in local events and charities, Lehigh Cement continues to raise awareness of conservation and community development.

**PRODUCT**

The cement products covered in this EPD meet UN CPC 3744 classification and the following standards:

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Applicable Standard</th>
<th>Standard Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Limestone Cement</td>
<td>ASTM C595, C1157, AASHTO M240</td>
<td>Type IL</td>
</tr>
<tr>
<td>Portland Cement</td>
<td>ASTM C150, C1157, AASHTO M85</td>
<td>Type I-II</td>
</tr>
<tr>
<td>Portland Cement</td>
<td>ASTM C150, C1157, AASHTO M85</td>
<td>Type III</td>
</tr>
<tr>
<td>Masonry Cement</td>
<td>ASTM C91</td>
<td>Type N, S</td>
</tr>
</tbody>
</table>
PRODUCT DESCRIPTION

This EPD reports environmental transparency information for four cement products, produced by Lehigh Cement at the Union Bridge, MD facility. These cements are hydraulic binders and are manufactured by grinding cement clinker and other main or minor constituents into a finely ground, usually grey colored mineral powder. Cement is just one ingredient in the mixture that creates concrete, but it is the most chemically active ingredient and crucial to the quality of the final product. When mixed with water, cement acts as a glue to bind together the sand, gravel, or crushed stone to form concrete, one of the most durable, resilient, and widely used construction materials in the world. Our Type IIL is branded as EcoCem™ and was developed to be more environmentally friendly by reducing its carbon footprint (reduction measured through GWP). This product is a general use product for concrete and mortar as well as all the other various applications for cement, including engineered soils and solidification/stabilization of materials and wastes.

DECLARED UNIT

The declared unit is one metric ton of Type IIL, Type I-II, Type III and Masonry Cement.

SYSTEM BOUNDARY

This EPD is a cradle-to-gate EPD covering A1-A3 stages of the life cycle.

<table>
<thead>
<tr>
<th>PRODUCTION STAGE</th>
<th>CONSTRUCTION STAGE</th>
<th>USE STAGE</th>
<th>END OF LIFE STAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extraction and upstream production</td>
<td>Transportation to Factory</td>
<td>Maintenance</td>
<td>Deconstruction / Demolition</td>
</tr>
<tr>
<td>Transport to Factory</td>
<td>Manufacturing</td>
<td>Use</td>
<td>Transport</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>Transport to site</td>
<td>Repair</td>
<td>Waste Processing</td>
</tr>
<tr>
<td>A1</td>
<td>A2</td>
<td>A3</td>
<td>A4</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>MND</td>
</tr>
</tbody>
</table>

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

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.
ALLOCATION PROCEDURE

Allocation follows the requirements and guidance of ISO 14044:2006, Clause 4.3.4; NSF PCR:2020; and ISO 21930:2017 section 7.2. Recycling and recycled content is modeled using the cut-off rule.

This sub-category PCR recognizes fly ash, silica fume, granulated blast furnace slag, cement kiln dust, flue gas desulfurization (FGD) gypsum, and post-consumer gypsum as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a cement material input.

LIFE CYCLE INVENTORY (LCI)

Primary Sources of LCI Data:
- **Coal**: ecoinvent 3.5 (2018) "Hard coal (RNA)| hard coal mine operation and hard coal preparation | Cut-off, U"
- **Natural Gas**: ecoinvent 3.5 (2018) "market for natural gas, high pressure US"
- **Petroleum Coke**: US-EI (2020) "Petroleum coke, at refinery/US"
- **Sand**: ecoinvent 3.5 (2018): "Silica sand {RoW}| production | Cut-off, U"
- **Train transport**: USLCI (2015) "Transport, train, diesel powered/US"
- **Truck transport**: USLCI (2015) "Transport, combination truck, long-haul, diesel powered, Northeast/tkm/RNA"

The resource mix is: 35.1% Coal, 29.8% Nuclear, 28.5% Natural Gas, 3.0% Wind, 1.1% Hydro, 1.1% Biomass, 0.5% Oil, 0.2% Solar, 0.6% Other Fossil. The GWP for this resource mix is 0.66 kg CO2e/kWh.

REFERENCES

Climate Earth 2021: Lehigh Cement – LCA Project Report, Union Bridge Plant
ecoinvent v3.5: 2018 The Swiss Centre for Life Cycle Inventories
ISO 21930:2017 Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services
NSF 2020: PCR for Portland, Blended, Masonry, Mortar and Plastic (Stucco) Cements v3.1, September 2020
USLCI: 2015 The U.S. Life Cycle Inventory Database
**LIFE CYCLE IMPACT ASSESSMENT RESULTS – Union Bridge Cement Products: Type IL named EcoCemPLC™, Type I-II, Type III, Masonry; per 1 metric tonne**

<table>
<thead>
<tr>
<th>Impact Assessment</th>
<th>Unit</th>
<th>Type IL</th>
<th>Type I-II</th>
<th>Type III</th>
<th>Masonry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global warming potential (GWP)(^1)</td>
<td>kg CO(_2) eq</td>
<td>801</td>
<td>856</td>
<td>877</td>
<td>492</td>
</tr>
<tr>
<td>Depletion potential of the stratospheric ozone layer (ODP)</td>
<td>kg CFC-11 eq</td>
<td>6.4E-06</td>
<td>5.92E-06</td>
<td>6.80E-06</td>
<td>4.99E-06</td>
</tr>
<tr>
<td>Eutrophication potential (EP)</td>
<td>kg N eq</td>
<td>1.26</td>
<td>1.32</td>
<td>1.37</td>
<td>0.79</td>
</tr>
<tr>
<td>Acidification potential of soil and water sources (AP)</td>
<td>kg SO(_2) eq</td>
<td>1.26</td>
<td>1.26</td>
<td>1.36</td>
<td>0.86</td>
</tr>
<tr>
<td>Formation potential of tropospheric ozone (POCP)</td>
<td>kg O(_3) eq</td>
<td>30.1</td>
<td>32.0</td>
<td>32.8</td>
<td>18.9</td>
</tr>
</tbody>
</table>

**Resource Use**

- Abiotic depletion potential for non-fossil mineral resources (ADPelemen)\(^*)\(^*\) kg Sb eq | 5.4E-06 | 5.23E-06 | 5.69E-06 | 4.58E-06 |
- Abiotic depletion potential for fossil resources (ADPfossil) MJ, NCV | 3,802 | 3,912 | 4,142 | 2,540 |
- Renewable primary energy resources as energy (fuel), (RPRE)\(^*)\(^*\) MJ, NCV | 45.8 | 39.2 | 48.3 | 37.7 |
- Renewable primary resources as material, (RP RM)\(^*)\(^*\) MJ, NCV | 0 | 0 | 0 | 0 |
- Non-renewable primary resources as energy (fuel), (NRP RE)\(^*)\(^*\) MJ, NCV | 4,460 | 4,456 | 4,830 | 3,089 |
- Non-renewable primary resources as material (NRPRM)\(^*)\(^*\) MJ, NCV | 0 | 0 | 0 | 0 |
- Consumption of fresh water m3 | 2.66 | 2.30 | 2.80 | 2.23 |

**Secondary Material, Fuel and Recovered Energy**

- Secondary Materials, (SM)\(^*)\(^*\) kg | 319 | 343 | 340 | 185 |
- Renewable secondary fuels, (RSF)\(^*)\(^*\) MJ, NCV | 0 | 0 | 0 | 0 |
- Non-renewable secondary fuels (NRSF)\(^*)\(^*\) MJ, NCV | 0 | 0 | 0 | 0 |
- Recovered energy, (RE)\(^*)\(^*\) MJ, NCV | 0 | 0 | 0 | 0 |

**Waste & Output Flows**

- Hazardous waste disposed* kg | 0 | 0 | 0 | 0 |
- Non-hazardous waste disposed* kg | 0 | 0 | 0 | 0 |
- High-level radioactive waste* kg | 3.57E-07 | 2.95E-07 | 3.73E-07 | 2.97E-07 |
- Intermediate and low-level radioactive waste* kg | 1.79E-06 | 1.50E-06 | 1.88E-06 | 1.48E-06 |
- Components for reuse* kg | 0 | 0 | 0 | 0 |
- Materials for recycling* kg | 3.59E+02 | 3.75E+02 | 3.75E+02 | 2.91E+02 |
- Materials for energy recovery* kg | 2.44E-02 | 2.55E-02 | 2.55E-02 | 1.98E-02 |
- Recovered energy exported from the product system* MJ, NCV | 0 | 0 | 0 | 0 |

**Additional Inventory Parameters for Transparency**

| CO\(_2\) emissions from calcination and uptake from carbonation\(^2\) kg CO\(_2\) eq | 441 | 484 | 485 | 257 |
| Biogenic CO\(_2\) reporting the removals and emissions associated with biogenic carbon content contained within biobased products kg CO\(_2\) eq | 0 | 0 | 0 | 0 |

* 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.

Only EPDs prepared from cradle-to-grave life-cycle results and based on the same function, quantified by the same functional unit, and taking account of replacement based on the product reference service life (RSL) relative to an assumed building service life, can be used to assist purchasers and users in making informed comparisons between products.

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\(^1\) GWP 100; 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5). Total CO2 facility combustion emissions are measured data from CO2 Continuous Emission Monitoring System (CEMS).

\(^2\) Calcination emissions were calculated based on the Cement CO2 and Energy Protocol detailed output method (B2) published by the World Business Council for Sustainable Development (WBCSD) Cement Sustainability Initiative (CSI).
ADDITIONAL ENVIRONMENTAL INFORMATION

Environmental Management System (EMS)

The Union Bridge Plant has an EMS in place. The EMS identifies environmental impacts, permit requirements and ensures that control procedures are continually updated to reflect current environmental knowledge and regulations. Environmental policies and procedures are written in the EMS manual and on Spectrac. Spectrac is a Microsoft Access Program that contains all air, water, waste and regulatory permit requirements. The program sends email notifications and updates to the appropriate listed designee on a monthly, quarterly, and annual timeframe. Environmental reporting complies with the U.S. EPA and the state of Maryland Department of Environmental Protection.

Air Permit

- The Union Bridge Plant is a Title V facility. The Title V Air Permit lists all requirements for both State and Federal reporting requirements and emissions limits.

Recycling Programs

- Used Oil, waste oil filters, fluorescent bulbs, batteries, office, and cardboard paper and used anti-Freeze.

Sustainability Commitments

Lehigh Cement, a Lehigh Hanson affiliated company, is a part of the HeidelbergCement Group, a leading construction materials company worldwide. HeidelbergCement's Sustainability Commitments 2030 define the key topics and core principles of Lehigh Cement's sustainability strategies, aligning with the UN Assembly Sustainable Development Goals (SDGs). Company sustainability performance ratings and ranking are publicly available at https://www.heidelbergcement.com/en/sustainability-report.

Lehigh Cement supports HeidelbergCement's Sustainability Commitments 2030. HeidelbergCement's goal of a 30% carbon footprint reduction as compared to 1990, encourages the discovery of innovative approaches and thought processes to reduce environmental impacts and ensure a sustainable business model. Working to incorporate knowledge and practices learned from global resources for local applications, Lehigh Cement continuously innovates to improve services and products that increase efficiency on the jobsite. Lehigh Cement also strives for effective management of all processes and resources and works with the local communities to promote resilient infrastructure and provide increased transparency. Lehigh Cement aligns and works globally with HeidelbergCement to push toward carbon neutral concrete by 2050. To learn more about Lehigh Cement's sustainability commitment, visit https://www.lehighhanson.com/about/sustainability.