This Environmental Product Declaration (EPD) covers eight concrete mixes produced by CEMEX Panama at its Juan Diaz plant.

Company Profile

CEMEX is a global building materials company that provides high-quality products and reliable service to customers and communities in more than 50 countries throughout the world, and maintains trade relationships in over 100 nations. We work hard to develop and deliver the best solutions in cement, ready-mix, admixtures and aggregates...so we can transform ideas into reality

Headquarters
CEMEX Panama
Calle 50 Edificio Credicorp Bank
Piso 28, CEMEX
Panama City
Panama
+507 278 8800

Plant
Juan Diaz Plant
Calle 124
Llano Bonito
Panama City
Panama
## NRMCA Certified Environmental Product Declaration

This environmental product declaration was conducted in accordance with ISO 14025:2006

- [ ] Internal Verification
- [x] External Verification

<table>
<thead>
<tr>
<th>Declared Product:</th>
<th>This Environmental Product Declaration (EPD) covers eight concrete mixes produce by CEMEX at its Juan Diaz plant in Panama City, Panama.</th>
</tr>
</thead>
</table>
| Declared Owner:   | CEMEX Panama  
+507 278-8800  
www.cemexpanama.com |
| Program Operator: | National Ready Mixed Concrete Association  
900 Spring St., Silver Spring, MD 20910  
www.nrmca.org/sustainability |
| LCA and EPD Developer: | CEMEX through WBCSD CSI-PCA tool for concrete and cement  
https://concrete-epd-tool.org |
| Independent Verifiers: | Jamie Meil, Research Principal  
Athena Sustainable Materials Institute  
119 Ross Avenue, Suite 100  
Ottawa, Ontario, Canada  
info@athenasmi.org |
| Product Category Rule: | North American Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) for Concrete, Version 1.1, dated 12/4/2013 (including clarifications #1, #2, and #3)  
The Carbon Leadership Forum  
www.carbonleadershipforum.org |
| Date of Issue: | September 1, 2017 |
| Period of Validity: | September 2017 – September 2022 |
| EPD Number: | NRMCAEPD:10014 |
Product description
This EPD reports the impacts for the product “ready-mix concrete” meeting the following specifications:

ASTM C94 - Standard Specification for Ready-Mixed Concrete

Declared unit
The declared unit is 1 m$^3$ of CEMEX concrete mix, at plant, for the CEMEX mixes names given in the table below:

<table>
<thead>
<tr>
<th>Mixture name</th>
<th>Compressive strength @ x days (psi)</th>
<th>Slump (cm)</th>
<th>Other Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-280-3-B-28-20-1-T-235</td>
<td>4000@28 days</td>
<td>20</td>
<td>Extended workability</td>
</tr>
<tr>
<td>6-280-5-B-28-15-1-T-000</td>
<td>4000@28 days</td>
<td>15</td>
<td>Pumpable</td>
</tr>
<tr>
<td>6-350-5-B-28-15-1-T-000</td>
<td>5000@28 days</td>
<td>15</td>
<td>Pumpable</td>
</tr>
<tr>
<td>6-490-3-B-56-65-1-T-30K</td>
<td>7000@56 days</td>
<td>65</td>
<td>High Strength Concrete. Pumpable</td>
</tr>
<tr>
<td>A-490-3-B-56-20-1-T-301</td>
<td>7000@56 days</td>
<td>20</td>
<td>High Strength Concrete. Pumpable</td>
</tr>
<tr>
<td>A-560-3-B-56-20-1-T-301</td>
<td>8000@56 days</td>
<td>20</td>
<td>High Strength Concrete. Pumpable</td>
</tr>
<tr>
<td>A-630-3-B-56-20-1-T-301</td>
<td>9000@56 days</td>
<td>20</td>
<td>High Strength Concrete. Pumpable</td>
</tr>
<tr>
<td>A-705-3-B-56-20-1-T-301</td>
<td>10000@56 days</td>
<td>20</td>
<td>High Strength Concrete. Pumpable</td>
</tr>
</tbody>
</table>

Product components
The components of the mixes included in this EPD meet the following standards:

<table>
<thead>
<tr>
<th>Component</th>
<th>Standard</th>
<th>Specification for:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregates</td>
<td>ASTM-C-33</td>
<td>Standard Specification for Concrete Aggregates</td>
</tr>
<tr>
<td>Admixtures</td>
<td>ASTM-C-494</td>
<td>Standard Specification for Chemical Admixtures for Concrete</td>
</tr>
<tr>
<td>Water</td>
<td>ASTM -C-1602</td>
<td>Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete</td>
</tr>
</tbody>
</table>
Life-cycle assessment

This EPD is based on a ‘cradle-to-gate’ life cycle assessment (LCA) of various ready mixed concretes. The life cycle processes included in the EPD are as follows:

- Raw material supply (upstream processes): Extraction, handling, and processing of the raw materials used in production of concrete: cement, supplementary cementitious materials, aggregate (coarse and fine), water, admixtures, and other materials or chemicals used in concrete mixtures.
- Transportation: Transportation of these materials from supplier to the gate of the concrete producer. And from the concrete plant to a delivery of 14 kilometer ratio to the client projects.
- Manufacturing (core processes): Energy used to store, batch, mix, and distribute the concrete and operate the facility (concrete plant).
- Water use in mixing and distributing concrete.

A summary of cradle-to-gate life cycle processes excluded from the EPD is as follows:

- Production, manufacture, and construction of buildings, capital goods, and infrastructure.
- Production and manufacture of concrete production equipment, concrete delivery vehicles, earthmoving equipment, and laboratory equipment.
- Personnel-related activities (travel, furniture, office supplies).

Energy and water use related to company management and sales activities.

A summary of the limitations of this EPD include the following:

- This EPD does not report all of the environmental impacts due to manufacturing of the product, but rather environmental impacts for categories with established LCA-based methods to track and report. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change, water use in the upstream manufacturing process, and habitat destruction.
- This EPD reports the results of an LCA for ‘cradle-to-gate’ analysis. Thus, declarations themselves are not comparative assertions, defined as an environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function. An EPD does not make any statements that the product covered by the EPD is better or worse than any other product.
- In order to assess the local impacts of product manufacturing, additional analysis is required.
- Life cycle impact assessment results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins, or risks.

This EPD has been developed using the Quantis 2016 (WBCSD-CSI tool for EPD of concrete and cement v1.3 - U.S. version, concrete-epd-tool.org).
Data quality, variability, and comparability

This EPD was created using plant-specific data for upstream materials. Potential variations due to supplier locations, manufacturing processes, and efficiencies and fuel use are thus accounted for in this EPD.

EPDs of concrete mixtures may not be comparable if they do not comply with this standard and data from this EPD. While EPDs can be used to compare concrete mixes, the data cannot be used to compare between construction products or concrete mixes used in different concrete products unless the data is integrated into a comprehensive LCA. For example, precast concrete, concrete masonry units, and site-cast concrete all have different manufacturing processes whose impacts are attributed to different LCA stages. This precludes direct comparison between mixes used in these different products until all life cycle phases are included.

Data sources and quality by source

This section provides the sources of data used to compute the upstream material life-cycle inventory (LCI) in this study accompanied by qualitative data quality assessments using the five indicators outlined in the “Product Life Cycle Accounting and Reporting Standard” [GHG Protocol 2011]. Data quality is rated “very good”, “good”, “fair”, or “poor” for each indicator.

Primary data

Quality of primary data is very good throughout all indicators as the data describe exactly the technologies, processes, and outputs analyzed in this study. All primary data refers to the full calendar year 2015.

Secondary data

Secondary data are data provided by a trade association, from a national survey or report or industry report, or a database and is based on data from more than one supplier or from an estimation of the data.

In this study the secondary is part of the WBCSD-CSI tool for EPDs of concrete and cement (v1.2), U.S. version [Quantis 2016]. Quantis as the authors of the tool consider that the overall quality of the data in the tool is good to very good; although they use a slightly different framework for quality assessment it is considered that this ranking is equivalent to the same ranking in the framework used here.
The following table summarizes the data sources used in WBCSD-CSI tool for EPDs of concrete and cement (v1.2), U.S. version for the main inputs at the ready-mix plant, and shows corresponding quality assessments.

<table>
<thead>
<tr>
<th>Process (unit)</th>
<th>LCI data source</th>
<th>Data quality assessment</th>
</tr>
</thead>
</table>
| Portland Cement (kg)            | **name**: CEMEX Panama (Bayano Plant)  
**database**: calculated in the tool from plant-specific data  
**Year**: 2016 |  
**technology**: very good  
**time**: very good  
**geography**: very good  
**completeness**: very good  
**reliability**: very good |
| Crushed coarse aggregate (kg)   | **name**: Gravel, crushed  
**database**: ecoinvent v3.1  
**geography**: rest of world (excluding Switzerland)  
**Year**: 2001 |  
**technology**: fair; process represents current technology (as of 2001) for gravel and sand quarry operations in Switzerland  
**time**: poor; data is older than ten years  
**geography**: fair; Process models production based on Swiss data and is adjusted for the rest of the world  
**completeness**: very good; process is 100% representative of Swiss production  
**reliability**: fair; Date is verified by ecoinvent with the following caveat: "This is a dataset automatically generated based on a dataset transferred from ecoSpold v1 / ecoinvent database version 2. It may not in all aspects fulfill the requirements of the ecoinvent data quality guideline for version 3." |
| Sand (kg)                       | **name**: Sand  
**database**: ecoinvent v3.1  
**geography**: rest of world (excluding Switzerland)  
**Year**: 2001 |  
**technology**: very good; process represents manufacture of chemical admixtures for concrete  
**time**: poor; data is older than 10 years  
**geography**: fair; process models European production (no US data in US LCI database)  
**completeness**: good; data is based on figures from four of Europe’s largest admixture producers  
**reliability**: fair; EPDs are not ISO-compliant |
| Accelerating admixture (kg)     | **name**: 300 Accelerator EPD  
**reference**: [EFCA 2006a]  
**geography**: Europe  
**Year**: 2006 |  
**technology**: very good; process represents manufacture of chemical admixtures for concrete  
**time**: poor; data is older than 10 years  
**geography**: fair; process models European production (no US data in US LCI database)  
**completeness**: good; data is based on figures from four of Europe’s largest admixture producers  
**reliability**: fair; EPDs are not ISO-compliant |
| Air-entraining admixture (kg)   | **name**: 301 Air Entrainer EPD  
**reference**: [EFCA 2006b]  
**geography**: Europe  
**Year**: 2006 |  
**technology**: very good; process represents manufacture of chemical admixtures for concrete  
**time**: poor; data is older than 10 years  
**geography**: fair; process models European production (no US data in US LCI database)  
**completeness**: good; data is based on figures from four of Europe’s largest admixture producers  
**reliability**: fair; EPDs are not ISO-compliant |
| Retarding admixture (kg)        | **name**: 302 Retarder EPD  
**reference**: [EFCA 2006c]  
**geography**: Europe  
**Year**: 2006 |  
**technology**: very good; process represents manufacture of chemical admixtures for concrete  
**time**: poor; data is older than 10 years  
**geography**: fair; process models European production (no US data in US LCI database)  
**completeness**: good; data is based on figures from four of Europe’s largest admixture producers  
**reliability**: fair; EPDs are not ISO-compliant |
| Plasticizing admixture (kg)     | **name**: 324 Plasticiser EPD  
**reference**: [EFCA 2006d]  
**geography**: Europe  
**Year**: 2006 |  
**technology**: very good; process represents manufacture of chemical admixtures for concrete  
**time**: poor; data is older than 10 years  
**geography**: fair; process models European production (no US data in US LCI database)  
**completeness**: good; data is based on figures from four of Europe’s largest admixture producers  
**reliability**: fair; EPDs are not ISO-compliant |
### Environmental impacts

This EPD covers the required set of environmental impact categories in accordance with the PCR, Section 3.2 [Carbon Leadership Forum 2013]:

<table>
<thead>
<tr>
<th>Impact category</th>
<th>Unit</th>
<th>Abbreviation</th>
<th>Impact Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life-cycle inventory items</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-renewable primary energy consumption</td>
<td>MJ</td>
<td>nPE</td>
<td>Gross Calorific (Higher Heating)</td>
</tr>
<tr>
<td>Renewable primary energy consumption</td>
<td>MJ</td>
<td>rPE</td>
<td>Gross Calorific (Higher Heating)</td>
</tr>
<tr>
<td>Total primary energy consumption</td>
<td>MJ</td>
<td>tPE</td>
<td>Gross Calorific (Higher Heating)</td>
</tr>
<tr>
<td>Concrete batching water consumption</td>
<td>m3</td>
<td>bCW</td>
<td></td>
</tr>
<tr>
<td>Concrete washing water consumption</td>
<td>m3</td>
<td>wCW</td>
<td></td>
</tr>
<tr>
<td>Total concrete water consumption</td>
<td>m3</td>
<td>tCW</td>
<td></td>
</tr>
<tr>
<td>Non-renewable material resource consumption</td>
<td>kg</td>
<td>nMR</td>
<td></td>
</tr>
<tr>
<td>Renewable material resource consumption</td>
<td>kg</td>
<td>rMR</td>
<td></td>
</tr>
<tr>
<td>Hazardous waste production</td>
<td>kg</td>
<td>hWP</td>
<td></td>
</tr>
<tr>
<td>Non-hazardous waste production</td>
<td>kg</td>
<td>nWP</td>
<td></td>
</tr>
<tr>
<td>Impact Categories</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global Warming</td>
<td>kg</td>
<td>GWP</td>
<td>TRACI 2.1</td>
</tr>
<tr>
<td>Ozone Depletion</td>
<td>kg</td>
<td>ODP</td>
<td>TRACI 2.1</td>
</tr>
<tr>
<td>Acidification</td>
<td>kg</td>
<td>AP</td>
<td>TRACI 2.1</td>
</tr>
<tr>
<td>Eutrophication</td>
<td>kg</td>
<td>EP</td>
<td>TRACI 2.1</td>
</tr>
<tr>
<td>Photochemical ozone creation</td>
<td>kg</td>
<td>POCP</td>
<td>TRACI 2.1</td>
</tr>
</tbody>
</table>
The calculation for computing the total primary energy consumption uses Gross Calorific Values (GCV), also known as Higher Heating Values (HHV).

The following table shows environmental impacts per m$^3$ of the CEMEX concrete mixes covered in this EPD using the abbreviations and units from the previous table.
<table>
<thead>
<tr>
<th>Mix Number</th>
<th>nPE</th>
<th>rPE</th>
<th>tPE</th>
<th>bCW</th>
<th>wCW</th>
<th>tCW</th>
<th>nMR</th>
<th>rMR</th>
<th>hWP</th>
<th>nWP</th>
<th>GWP</th>
<th>ODP</th>
<th>AP</th>
<th>EP</th>
<th>POCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-280-3-B-28-20-1-T-235</td>
<td>2603</td>
<td>562</td>
<td>2603</td>
<td>0.185</td>
<td>0.280</td>
<td>5.44</td>
<td>2424</td>
<td>18.2</td>
<td>0</td>
<td>0.068</td>
<td>318</td>
<td>1.83E-05</td>
<td>1.07</td>
<td>0.296</td>
<td>19.9</td>
</tr>
<tr>
<td>6-280-5-B-28-15-1-T-000</td>
<td>2003</td>
<td>541</td>
<td>2544</td>
<td>0.178</td>
<td>0.280</td>
<td>5.20</td>
<td>2446</td>
<td>17.5</td>
<td>0</td>
<td>0.068</td>
<td>309</td>
<td>1.82E-05</td>
<td>1.04</td>
<td>0.283</td>
<td>19.4</td>
</tr>
<tr>
<td>6-350-5-B-28-15-1-T-000</td>
<td>2841</td>
<td>624</td>
<td>2841</td>
<td>0.175</td>
<td>0.280</td>
<td>5.39</td>
<td>2473</td>
<td>20.5</td>
<td>0</td>
<td>0.068</td>
<td>354</td>
<td>1.95E-05</td>
<td>1.16</td>
<td>0.321</td>
<td>21.4</td>
</tr>
<tr>
<td>6-490-3-B-56-65-1-T-30K</td>
<td>2805</td>
<td>756</td>
<td>3561</td>
<td>0.170</td>
<td>0.280</td>
<td>6.24</td>
<td>2506</td>
<td>25.2</td>
<td>0</td>
<td>0.068</td>
<td>435</td>
<td>2.57E-05</td>
<td>1.51</td>
<td>0.422</td>
<td>25.7</td>
</tr>
<tr>
<td>A-490-3-B-56-20-1-T-301</td>
<td>2467</td>
<td>706</td>
<td>3174</td>
<td>0.165</td>
<td>0.280</td>
<td>6.20</td>
<td>2550</td>
<td>23.3</td>
<td>0</td>
<td>0.068</td>
<td>398</td>
<td>2.14E-05</td>
<td>1.32</td>
<td>0.374</td>
<td>23.7</td>
</tr>
<tr>
<td>A-560-3-B-56-20-1-T-301</td>
<td>2697</td>
<td>792</td>
<td>3490</td>
<td>0.172</td>
<td>0.280</td>
<td>6.50</td>
<td>2577</td>
<td>26.4</td>
<td>0</td>
<td>0.068</td>
<td>444</td>
<td>2.29E-05</td>
<td>1.45</td>
<td>0.417</td>
<td>25.8</td>
</tr>
<tr>
<td>A-630-3-B-56-20-1-T-301</td>
<td>2932</td>
<td>898</td>
<td>3830</td>
<td>0.173</td>
<td>0.280</td>
<td>6.48</td>
<td>2613</td>
<td>30.2</td>
<td>0</td>
<td>0.068</td>
<td>498</td>
<td>2.39E-05</td>
<td>1.59</td>
<td>0.456</td>
<td>28.2</td>
</tr>
<tr>
<td>A-705-3-B-56-20-1-T-301</td>
<td>3229</td>
<td>982</td>
<td>4212</td>
<td>0.178</td>
<td>0.280</td>
<td>7.51</td>
<td>2635</td>
<td>33.1</td>
<td>0</td>
<td>0.068</td>
<td>547</td>
<td>2.64E-05</td>
<td>1.76</td>
<td>0.518</td>
<td>30.6</td>
</tr>
</tbody>
</table>
References

- Swiss Center for Life Cycle Inventories, ecoinvent v3.1, Zürich, Switzerland, http://www.ecoinvent.org
- Quantis 2016 WBCSD-CSI tool for EPD of concrete and cement v1.3 - U.S. version, concrete-epd-tool.org