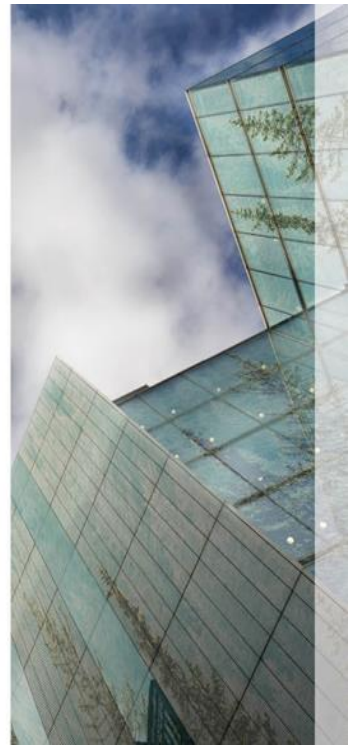
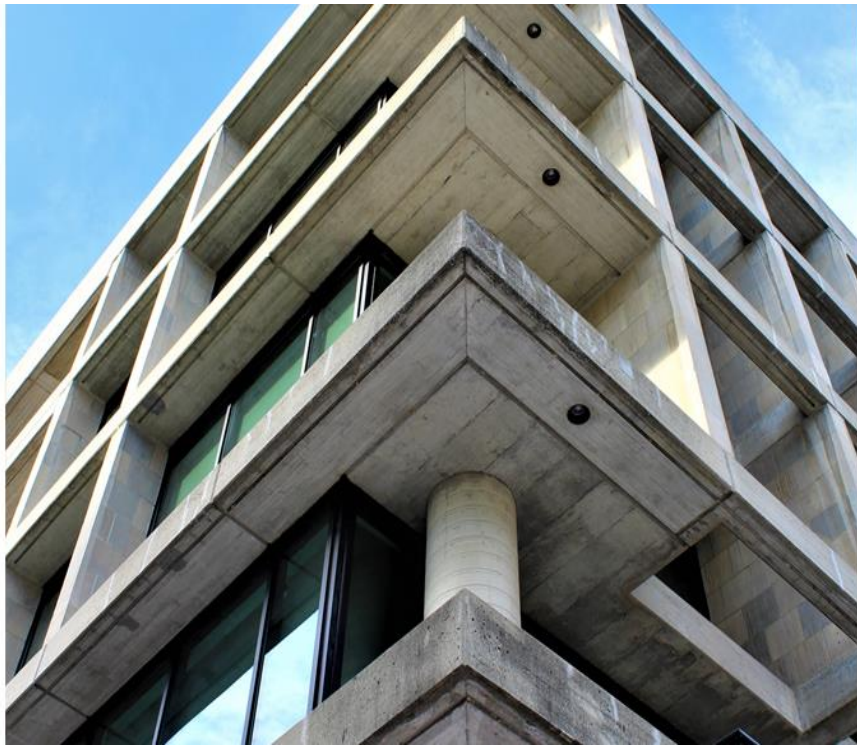




# Product Category Rule for Environmental Product Declarations

*PCR for Concrete*



**Program Operator**  
NSF International  
National Center for Sustainability Standards  
Valid through February 22, 2024  
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## PCR REVISION HISTORY

Version	Date issued
Version 1 (published by Carbon Leadership Forum)	November 2012
Version 1.1 (published by Carbon Leadership Forum)	December 2013
Version 2	February 2019
Version 2.1	August 2021

Published by  
**NSF International**  
PO Box 130140, Ann Arbor, Michigan 48113-0140, USA

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Printed in the United States of America.



PCR for  
Concrete

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*NSF International shall ensure that reasonable balance among the members of a PCR committee is achieved and potential conflicts of interest were resolved prior to commencing this PCR development. No participation fees will be charged by NSF International to interested parties for participation on PCR Development Committees, for attendance at PCR Development Committee meetings, or for commenting on a draft PCR document.*



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Through the National Center for Sustainability Standards, NSF develops life-cycle based, multi-attribute sustainability standards, protocols, and PCRs for various industries including building products and materials, furniture, carpet and flooring, fabrics, wallcoverings, roofing membranes, green chemicals, and water and wastewater.

The National Center for Sustainability Standards will continue to add to its growing portfolio while providing education, outreach, and innovative support to private industry, trade associations, government and academia to foster a consensus-based approach toward conformity assessment in the sustainability field. Visit [www.nfsustainability.org](http://www.nfsustainability.org) or contact [ncss@nsf.org](mailto:ncss@nsf.org).

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## **ABOUT NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)**

NRMCA, a non-profit organization based in Silver Spring, MD, represents the producers of ready mixed concrete and the companies that provide materials, equipment and support to the industry. It conducts education, training, promotion, research, engineering, safety, environmental, technological, lobbying and regulatory programs. For more information on NRMCA's Sustainability Initiatives, visit the following link: [www.nrmca.org/sustainability](http://www.nrmca.org/sustainability).





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## PCR DEVELOPMENT AND STAKEHOLDER CONSULTATION

This product category rule for 'concrete' is Version 2.1 of the Product Category Rules (PCR) for ISO 14025:2006 Type III Environmental Product Declarations (EPDs) of Concrete, updating Version 2 dated February 2019. The following change has been included in this document:

- updated background data sets (Appendix A).

A committee outlined in Appendix B provided review and input to the revisions. After consideration of existing North American PCRs for concrete materials and products (hosted at ASTM), the new USGBC PCR Guidance Document, European PCRs for concrete and ISO 21930:2017 (see references) the technical committee decided to use ISO 21930:2017 as the 'core PCR' and adapt the CLF Concrete PCR to be a 'sub-category PCR'.

ISO 21930:2017 provides the core rules for construction products and services and must be read in tandem with this document. Technical issues in this sub-category PCR related to concrete production build from the CLF Concrete PCR and align with the ASTM PCR for Precast Concrete (UN CPC 37550) in order to increase standardization of LCA practice in regions that use ASTM standards for concrete.

For information about PCR development and stakeholder consultation, see Appendix B.

The development of this PCR was supported by The National Ready Mixed Concrete Association, and The Carbon Leadership Forum's sponsors:

- Mithun, the Russell Family Foundation, Stop Waste
- Arup, Central Concrete, Interface, Orka Aggregates, Skanska, Thornton Tomasetti
- Climate Earth, Magnusson Klemencic Associates, NRMCA
- Owens Corning, Simpson Gumpertz & Heger, Thinkstep, Urban Fabrick, Walter P Moore



## 1 SCOPE

Per ISO 21930:2017 Section 1 with the following additions:

This subproduct category rule (PCR) addresses UN CPC Group 375 – Concrete and enables the development of environmental product declarations (EPDs) associated with the production of that product from cradle-to-gate. This PCR was developed specifically for use where applicants use the following standards: ASTM C94, CSA A23.1/A23.2, UNSPSC code 30111500. An additional PCR is required for concrete products to outline the additional LCA stages such as formwork, reinforcement and curing.

The materials commonly used in concrete are listed in Table 1.

**Table 1**  
**Concrete materials**

Materials	Description / specification
Portland cement	ASTM C150, AASHTO M 85, or CSA A3001
blended hydraulic cements	ASTM C595, AASHTO M 240, or CSA A3001
Portland-limestone cement	ASTM C595, AASHTO M 240, or CSA A3001
performance-based hydraulic cement	ASTM C1157
fine aggregate – natural sand	ASTM C33/C33M, CSA A23.1
fine aggregate – manufactured	ASTM C33/C33M, CSA A23.1
coarse aggregate – natural gravel	ASTM C33/C33M, CSA A23.1
coarse aggregate – rushed	ASTM C33/C33M, CSA A23.1



PCR for  
Concrete

**Table 1**  
**Concrete materials**

Materials	Description / specification
lightweight aggregates	ASTM C330/C330M
supplementary cementitious materials (SCMs) – fly ash	ASTM C618, AASHTO M 295, AASHTO M 302, CSA A3000
SCMs – silica fume	ASTM C1240, CSA A3000
SCMs – blast furnace slag cement	ASTM C989/C989M, AASHTO M 302, CSA A3000
SCMs – natural pozzolan	ASTM C618, CSA A3000
chemical admixture – accelerators	ASTM C494/C494M Type C/E
chemical admixture – air entraining agent	ASTM C260/C260M
chemical admixture – hardening accelerators	ASTM C494/C494M Type C
chemical admixture – plasticizer and superplasticisers	ASTM C494/C494M Type F/G, ASTM C1017/C1017M
chemical admixture – retarders	ASTM C494/C494M Type B/D
chemical admixture – water reducing / resisting	ASTM C494/C494M Type A/B/D/E
chemical admixture – coloring	ASTM C979/C979M
chemical admixture – corrosion inhibitors	ASTM C494 Type C/E, ASTM C1582/C1582M
fibers	ASTM C1116





**Table 1**  
**Concrete materials**

Materials	Description / specification
pigments	ASTM C979/C979M
net consumables	Items such as lubricants, grease and oils used in manufacturing
batch water	ASTM C1602
wash water	N/A



## 2 NORMATIVE REFERENCES

The following documents are referred to in the text. For undated reference, the latest edition of the referenced document (including any amendments) applies.

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

Per ISO 21930:2017 Section 2, with the following additions:

- ASTM C94, *Standard Specification for Ready-Mixed Concrete*; and
- CSA A23.1/A23.2, *Concrete materials and methods of concrete construction / Test methods and standard practices for concrete*.



### 3 TERMS AND DEFINITIONS

While this PCR will likely be used primarily in North America, it may be used in other regions where program operators deem it appropriate. Per ISO 21930:2017 Section 3, with the following additions:

**concrete:** Concrete is a composite material that consists of a binding medium (cement paste, hydraulic cement and water, and possibly one or more admixtures) embedded with fine aggregate (typically sand) and coarse aggregate (typically gravel) to form a hard solid mass. While the most widely used hydraulic cement is Portland cement, other hydraulic cements include blended cements and cementitious material such as ground granulated blast furnace slag (GGBFS). Pozzolans, both natural and artificial (e.g., fly ash and silica fume) are often used as a cementitious ingredient of concrete (adapted from the definition by Mather and Ozyildirim).

**admixture:** Constituent added during the mixing process in small quantities related to the mass of cement to modify the properties of fresh or hardened concrete (per EN 206:2013 + A1:2016).

**aggregate:** Granular material of natural, manufactured, or recycled origin used in construction (per EN 12620:2002 + A1:2008).

**cement:** Finely ground inorganic material which, when mixed with water, forms a paste that sets and hardens by means of hydration reactions and processes and which after hardening, retains its strength and stability even under waterp (per EN 197-1:2011).

**binder:** Combination of cement and reactive (type II additions) (per EN 16757:2017).

**EPD brief:** A public report of EPD results that includes less detailed information about the LCA to reflect market demand (e.g., LEED v4) for selected impact categories.

**cubic meter (metre) of concrete:** Quantity of fresh concrete, which occupies a volume of one cubic meter (adapted from EN 16757:2017).

**net consumables:** Items used during manufacturing, such as lubricants, grease and oils.



**product specific EPD:** EPD results for a specific product or group of concrete mix designs categorized by performance developed by a manufacturer for a specific ready mix plant location.

**industry average EPD:** EPD results for a specific product or group of concrete mix designs categorized by performance for a specified region.

**hazardous waste:** Waste identified as hazardous according to regulations applicable in the market for which the EPD is valid. For the US market, wastes are hazardous if they are regulated under the Resource Conservation and Recovery Act <[www.epa.gov/rcra](http://www.epa.gov/rcra)>; see also 40 CFR 261.33 <[www.govinfo.gov/content/pkg/CFR-2011-title40-vol26/pdf/CFR-2011-title40-vol26-sec261-33.pdf](http://www.govinfo.gov/content/pkg/CFR-2011-title40-vol26/pdf/CFR-2011-title40-vol26-sec261-33.pdf)>. For the Canadian market wastes are hazardous if they are regulated under the Canadian Environmental Protection Act, 1999 Regulations <[www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/permit-hazardous-wastes-recyclables/management.html](http://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/permit-hazardous-wastes-recyclables/management.html)>.

NOTE — Hazardous waste does not include radioactive waste; see ISO 21930:2017 Section 7.2.14.

**non-hazardous waste:** Commercial / industrial waste that is not hazardous: dust, spoil and other waste from raw materials extraction; waste treated in municipal disposal scheme; and leftover or waste concrete and neutral pH yard scrapings.

## 4 ACRONYMS AND ABBREVIATED TERMS

Per ISO 21930:2017 Section 4, with the following additions:

<b>CLF</b>	Carbon Leadership Forum
<b>GGBFS</b>	ground granulated blast furnace slag cement
<b>LEED</b>	Leadership in Energy and Environmental Design
<b>USGBC</b>	US Green Building Council



## 5 GENERAL ASPECTS

### 5.1 Objectives of this PCR

Per ISO 21930:2017 Section 5.1, with the following additions:

- the primary objective of this PCR is to provide common rules specific to concrete for the application of ISO 21930:2017 for building and civil engineering works.

Additional objectives include to:

- describe which stages of a product's life cycle are considered in the EPD and which processes are to be included in the life cycle stages;
- encourage concrete producers to quantify, report, better understand and reduce the environmental impacts of concrete;
- promote transparency and incentivize manufacturer specific upstream data;
- represent concrete appropriately following international standards for building materials and products;
- specify the data quality and default data to be used in concrete EPDs;
- support the use and guidance of EPDs in sustainable design construction programs and ratings;
- address requirements for creating an industry average EPD to enable a pathway towards comparative assessment against company specific EPDs (per LEED v4 MR Credit: Building product disclosure and optimization – Environmental declarations); and
- enable consistent and comparable reporting of LCA results related to concrete production.





## 5.2 Life cycle stages

Per ISO 21930:2017 Section 5.2, with the following clarifications:

- this PCR enables reporting of a cradle-to-gate with options EPD as outlined in ISO 21930:2017 Section 5.2.2.

## 5.3 Average EPDs for groups of similar products

Per ISO 21930:2017 Section 5.3, with the following clarifications and additions:

- examples of average EPD grouping for concrete products include: performance categories of compressive strength and high early strength; material characteristics of lightweight concrete; and production categories of ready-mix and central-mix;
- if any environmental indicators for products included in the average differ by more than  $\pm 10\%$ , the minimum and maximum of the population or dataset shall be reported. Alternately, if a single value is chosen for each impact category for all products, the value reported should be the highest impact within the range of variation, therefore the EPD would report the highest single value for each impact category amongst all of the products or plants included in the average EPD analysis;
- manufacturers seeking to benchmark their individual type III EPDs against an industry average EPD shall have participated in the industry average EPD; and
- for full transparency, product specific EPDs are encouraged.

## 5.4 Use of EPDs for construction products

Per ISO 21930:2017 Section 5.4, with the following clarifications:

- this PCR is to create EPDs for use in business-to-business (B2B) communication.



## 5.5 Comparability of EPDs for construction products

Per ISO 21930:2017 Section 5.5, with the following clarifications and additions:

- comparison based on LCA A1-A3 data, shall be made only if the same secondary data sets, and all subsequent life cycle stages are equivalent for both EPDs; and
- if concrete EPDs are used to compare two different concrete mixes, the functional units must be the same. Additionally, the following conditions must be met:
  - the concrete mixes have the same or superior structural, thermal and exposure properties; and
  - for product specific EPD comparisons, results for transportation reflect actual transportation distances.

## 5.6 Comparability of EPDs for construction products

Per ISO 21930:2017 Section 5.6, with the following additions:

- in addition to the EPD and project report as outlined in ISO 21930:2017, the results of the EPD may be reported in an EPD brief. EPD briefs may include less detailed information about the LCA, may aggregate Life Cycle Stages A1-A3, and fewer environmental impact categories and/or inventory indicators. The requirements for an EPD brief are given in Section 9.5.



## 6 PCR DEVELOPMENT AND USE

Per ISO 21930:2017 Section 6, with the following additions:

- this PCR document is effective for five (5) years from the latest date of publication. If after five years, relevant changes in the product category or other relevant factors have occurred (for example, evolution of LCA methodology in ISO 21930:2017), the document will be revised. See Section 5.5 for comparability.



## 7 PCR FOR LCA

### 7.1 Methodological framework

#### 7.1.1 LCA modeling and calculation

Per ISO 21930:2017 Sections 7.1.1, and Sections 7.2.3 through 7.2.6.

#### 7.1.2 Functional unit

Per ISO 21930:2017 Section 7.1.2, with the following clarifications and additions:

- no functional unit is defined in this PCR. However, performance characteristics of concrete shall be reported including:
  - UNSPC Product code and CSI Specification number; and
  - specified compressive strength at specified age in days (e.g., 4,000 psi (28 MPa) at 28 days). Compressive strength can be presented in either SI or US units or both as appropriate for the application.

Additionally, the EPD may include other specified characteristics such as:

- specified environmental exposure class (per ACI 318-14, CSA A23.1 or other specified or accepted standard) (e.g., Exposure Class F1, S0, P0, C1 or F0-F3, S0, P0-P1, C0-C2);
- design slump or slump flow. Example: 4 to 6 in (10 to 15 cm); and
- any other specified characteristic that affects concrete performance (e.g. air entrainment, unit weight, high early strength requirements, etc.).

Alternatively, the EPD may provide the minimum specification product descriptions, such as compressive strength (5,000 psi 35 MPa); multiple exposure classes; a range of slump or slump flow values; or a range of additional characteristics for EPDs that represent various concrete mixture designs.



### 7.1.3 Declared unit

Per ISO 21930:2017 Section 7.1.3, with the following clarifications:

- since this PCR only covers Module A (manufacturing), a declared unit shall be used. The declared unit shall be one cubic meter of concrete. Data may additionally be presented per US cubic yards or tonnes (1,000 kg).

### 7.1.4 Reference service life

Per ISO 21930:2017 Section 7.1.4, with the following clarifications:

- as this PCR does not address Module B (use), the reference service life (RSL) of concrete is not addressed.

### 7.1.5 System boundary with nature

Per ISO 21930:2017 Section 7.1.5.

### 7.1.6 System boundary between product systems

Per ISO 21930:2017 Section 7.1.6.

### 7.1.7 System boundaries and technical information for scenarios

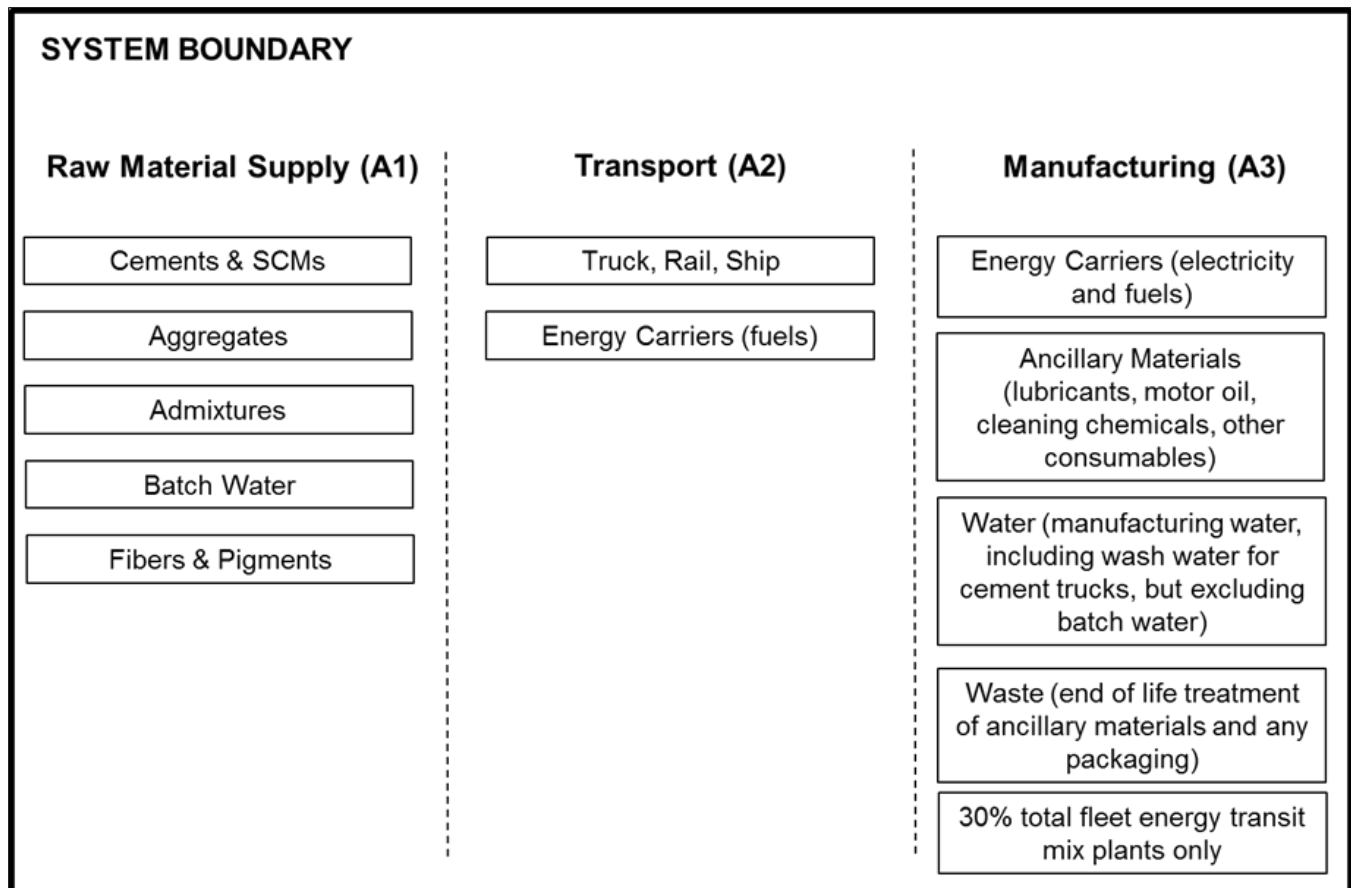
Per ISO 21930:2017 Section 7.1.7, with the following additions:

- a general system boundary diagram is found in Figure 1.





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**Figure 1**  
**Example system boundary diagram**

Items that may be excluded from the 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.



### 7.1.7.1 General

Per ISO 21930:2017 Section 7.1.7.1.

### 7.1.7.2 A1 to A3, production stage

Per ISO 21930:2017 Section 7.1.7.2, with the following additions:

- A1 shall include the constituents of concrete listed in Table 1;
- A2 shall assume all long haul transport by bulk carriers (greater than 322 km (200 mi)) do not typically return empty and thus can use the US LCI dataset which includes 35% additional distance to account for this;
- A2 shall assume that all short haul transport (local trucks and dump trucks) return empty. Thus, one way transport distance shall be multiplied by (2/1.35) to reflect two way transport and eliminate the 35% additional distance included in the US LCI;
- A3 shall include transportation activities at the concrete manufacturing site;
- A3 shall include an assumption of 5% material loss unless product specific data is available and transparently reported in the project LCA report underlying the EPD;
- A3 shall include ancillary materials which include, but are not limited to, lubricating oils, engine oils, & other consumable operations equipment maintenance (OEM) products;
- A3 shall include final end of life treatment for any manufacturing waste. For example, admixture and ancillary material packaging. Concrete returned from construction sites is not included in A3; it is included in the construction process Stage A5; and



— for all truck (transit) mixing plant operations covered in the EPD, a default factor of 30% of all mixing truck (fleet) energy use is to be allocated to Module A3, regardless of whether A4 is reported. This default is to be applied and quoted in the EPD unless a specific power takeoff analysis has been completed and is transparently documented in the project LCA report underlying the EPD (per Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, SAFETEA-LU, Section 11144 – PTO Report, SB/SE Research – Philadelphia, Project ID–PHL0019, July 2007, Appendix E).

#### **7.1.7.3 A4 to A5, construction stage**

Per ISO 21930:2017 Section 7.1.7.3, with the following additions:

- A4 is optional. If provided, a description of the reference scenarios shall be part of the EPD;
- A4, if included, shall include:
  - backhaul; and
  - the remaining 70% of mixing truck (fleet) energy.
- A5 is optional, but when placement of concrete is included, it shall include the impacts of concrete ordered but not used and returned. Returned concrete shall be considered a waste product and can be used as a burden free input until the point at which it is recovered and processed for further use, and that impacts from recovery and processing operations shall be included in Modules A1-A3 of the system using the secondary material.

#### **7.1.7.4 Use stage**

This section of ISO 21930:2017 does not apply.

#### **7.1.7.5 C1 to C4, end-of-life-stage**

This section of ISO 21930:2017 does not apply.



**7.1.7.6 Benefits and loads beyond the system boundary in optional supplementary Module D**

This section of ISO 21930:2017 does not apply.

**7.1.8 Criteria for the inclusion and exclusion of inputs and outputs**

Per ISO 21930:2017 Section 7.1.8.

**7.1.9 Selection of data and data quality requirements**

Per ISO 21930:2017 Section 7.1.9, with the following modifications and additions:

- ISO 21930:2017 (Table 3) shall be supplemented by Table 2 with additional detail on the upstream data to use in developing the EPD.

**Table 2  
Application of data within Module A1**

	<b>Production of commodities, raw materials</b>
process type	upstream processes
preferred data	use product specific EPD
if preferred data doesn't exist	per Appendix A





### 7.1.11 Units

Per ISO 21930:2017 Section 7.1.10, with the following additions:

— as noted in ISO 21930:2017, SI units shall be used. Optionally, EPD may provide both US and metric units using the following conversion factors:

Convert from:	Convert to:	Multiply by:
cubic yard (yd <sup>3</sup> )	cubic meter (m <sup>3</sup> )	7.654 549 E-01
square foot (ft <sup>2</sup> )	square meter (m <sup>2</sup> )	9.290 304 E-02
foot (ft)	meter (m)	3.048 E-01
British Thermal Unit (BTU)	megajoule (MJ)	1.055 056 E-03
pound (lb)	kilogram (kg)	4.535 924 E-01

Source: NIST <[physics.nist.gov/Pubs/SP811/appenB9.html](https://physics.nist.gov/Pubs/SP811/appenB9.html)>

### 7.2 Inventory analysis

Per ISO 21930:2017 Section 7.2, with the following additions and clarifications to Sections 7.2.4 to 7.2.6, and additions:

— the following materials shall be considered recovered materials and not co-products as is consistent with version 1 of the *PCR for Concrete* and the *ASTM PCR for Precast Concrete*:

- fly ash;
- blast furnace slag (as a cement); and



— silica fume.

As in the ASTM *PCR for Precast Concrete*, concrete recycling processes may be treated as closed-loop recycling when the recycled concrete is used as a material input for the production of manufactured concrete and concrete masonry products. In this case only the flows and impacts associated with transportation, recovery and crushing of the recycled concrete shall be taken into account and the need for allocation is avoided since the use of secondary material displaces the use of virgin (primary) materials.

If different allocation options are relevant and a deviation of greater than 20% is a foreseen outcome, a sensitivity analysis shall be initiated. These different allocation approaches and data sets shall be documented and declared in the EPD.

Where potable water from a municipal source is used, the water treatment and distribution systems shall be included as an upstream process, which will have its own resource use and discharges. The impacts of water desalination shall be included.

### 7.3 Impact assessment indicators describing main environmental impacts derived from LCA

Per ISO 21930:2017 Section 7.3, with the following clarifications:

— ISO 21930:2017 greatly expands the indicators required to be reported. Often the best currently available data such as industry average EPDs for upstream processes do not yet align with ISO 21930:2017.



## 8 ADDITIONAL ENVIRONMENTAL INFORMATION

Per ISO 21930:2017 Section 8.

NOTE — ISO 21930:2017 Section 8.4.1 includes requirements for hazardous materials reporting.



## 9 CONTENT OF AN EPD

### 9.1 General

Per ISO 21930:2017 Section 9.1.

### 9.2 Declaration of general information

Per ISO 21930:2017 Section 9.2, with the following clarifications:

- a simple visual representation of ready mixed concrete is not relevant and thus not required;
- as the percentage of material components can be considered proprietary information, the list of materials should be reported in order of greatest mass per mix; and
- include the following table in lieu of ISO 21930:2017, Figure 3:

<p>ISO 21930:2017 Sustainability in Building Construction — Environmental Declaration of Building Products: serves as the core PCR</p> <p>&lt;Insert Concrete PCR V2 final name&gt; serves as the sub-category PCR</p> <p>Sub-category PCR review was conducted by:</p> <p>&lt;Insert name and organization of the panel chair and their contact information&gt;</p> <p>Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025: &lt;insert year of publication&gt;</p> <p><input type="checkbox"/> internal                      <input type="checkbox"/> external</p> <p>Third-party verifier:</p> <p>&lt;name and contact information of third party verifier&gt;</p> <p>For additional explanatory material:</p> <p>&lt;name and email of manufacturer’s representative&gt;</p> <p>&lt;name and version of EPD software tool (if applicable)&gt;</p>
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### 9.3 Declaration of the methodological framework

Per ISO 21930:2017 Section 9.3, with the following additions and clarifications:

- for cradle-to-gate EPDs, scenarios are not required to be reported. The EPD shall include the following:

- the note:

*“The product category rules for this EPD recognize fly ash, silica fume, and 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 concrete material input.”*

- a table summarizing the life cycle stages included in the EPD:

Product stage			Construction process stage		Use stage								End-of-life stage			
extraction and upstream production	transport to factory	manufacturing	transport to site	installation	use	maintenance	repair	replacement	refurbishment	operational energy use	operational water use	deconstruction / demolition	transport	waste processing	disposal of waste	extraction and upstream production
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	A1

- a table outlining the primary sources of data used to complete the upstream material LCI background data including the date or version number;

- for industry average EPDs, include the date and source of industry data survey including a list of all companies who participated in the EPD data; and





- one of three statements, addressing GWP 100 (years), ODP, EP, AP, and POCP impact categories:
  - *“This EPD was calculated using industry average cement data. Cement LCA impacts can vary depending upon manufacturing process, efficiency and fuel source by as much as 50% for some environmental impact categories. Cement accounts for as much as <insert max %> of the impacts of the concrete mixes included in this EPD and thus manufacturer specific cement impacts could result in variation of as much as <insert max %>;”*

NOTE — Calculation procedure: If the max percentage of impacts for any impact category for any mix reported in the EPD is 85%, then you multiply 85% by 50% to get a max variation of 42.5% and the statement would read: "Cement accounts for as much as 85% of the impacts of the concrete mixes included in this EPD and thus manufacturer specific cement impacts could result in variation of as much as 42.5%.

- *“This EPD was calculated using manufacturer specific cement data that represents <insert %> of the total cement used in this mix;”* or
- *“This EPD was calculated using manufacturer specific cement data that represents an average of <insert %> of the total cement used in each mix included in this EPD.”*

#### 9.4 Declaration of technical information and scenarios

ISO 21930:2017 Section 9.4 does not apply for cradle-to-gate EPDs.

#### 9.5 Declaration of environmental indicators derived from LCA

Per ISO 21930:2017 Section 9.5, with the following additions:

- the following additional LCA results shall be included in the EPD:
  - abiotic depletion potential for non-fossil mineral resources (ADP elements).



— the following clarifications shall be applied and notes added:

— many of the impacts and inventory items included in ISO 21930:2017 are emerging and have high levels of uncertainty. This shall be recognized within the EPD with the following note (can be listed as shown below or identified by the word 'note':

*“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.”*

- renewable primary energy resources as energy (fuel), (RPR<sub>E</sub>);
- renewable primary resources as material, (RPR<sub>M</sub>);
- nonrenewable primary resources as energy (fuel) ,(NRPR<sub>E</sub>);
- nonrenewable primary resources as material (NRPR<sub>M</sub>);
- secondary materials (SM);
- renewable secondary fuels (RSF);
- nonrenewable secondary fuels (NRSF);
- recovered energy (RE);
- abiotic depletion potential for nonfossil mineral resources (ADP elements);
- land use related impacts, for example on biodiversity and/or soil fertility;
- toxicological aspects;
- emissions from land use change [GWP 100 (land-use change)];
- hazardous waste<sup>1</sup> disposed;
- nonhazardous waste disposed;
- high-level radioactive waste;
- intermediate and low-level radioactive waste;
- components for reuse;
- materials for recycling;
- materials for energy recovery;
- recovered energy exported from the product system.

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<sup>1</sup> As defined by RCRA under 40 CFR 261.33. <[www.govinfo.gov/content/pkg/CFR-2011-title40-vol26/pdf/CFR-2011-title40-vol26-sec261-33.pdf](http://www.govinfo.gov/content/pkg/CFR-2011-title40-vol26/pdf/CFR-2011-title40-vol26-sec261-33.pdf)>



— when upstream data specified in the PCR and/or used in calculating the EPD do not have data for select impact categories or inventory items, they shall be reported as an 'x' or '-' and not zero and qualified with the note:

*“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.”*

## 9.6 EPD brief

A EPD brief may be published and report fewer impact categories than the EPD. A EPD brief must include all additional information and statements required in the EPD and provide a link to the EPD:

— add statement to the EPD brief:

*“This EPD brief does not report all of the impact categories required by ISO 21930:2017. Additional detail and environmental impacts are reported in the complete EPD available.”*

A EPD brief may report a single result aggregating life cycle Stages A1, A2 and A3 and at a minimum must report the following required impact categories and inventory items:

- global warming potential (GWP 100);
- ozone depletion potential (ODP);
- eutrophication potential (EP);
- acidification potential (AP);
- photochemical smog creation potential (POCP);
- abiotic depletion potential for nonfossil mineral resources (ADP elements).
- abiotic depletion potential for fossil resources (ADP fossil);
- total waste disposed (kg);
- consumption of freshwater (per ISO 21930:2017, Section 7.2.13).



## 9.7 Declaration of additional environmental information

Per ISO 21930:2017 Section 9.6, with the following additions:

- the following optional additional information may be reported as a separate inventory item:
  - carbon sequestered in product (kg). Methodology must be documented and publicly reported.
- the following references shall be provided at a minimum in the EPD:
  - ISO 21930:2017, *Sustainability in Building Construction — Environmental Declaration of Building Products*.



## 10 PROJECT REPORT

Per ISO 21930:2017 Section 10.



## 11 VERIFICATION AND VALIDITY OF AN EPD

Per ISO 21930:2017 Section 11, with the following additions:

- EPD calculations completed by software systems are permitted provided the software has been verified per similar procedures as verifying an EPD. The process used to verify the software calculations should be publicly accessible and referenced from the EPD;
- when a product specific EPD is aligned with an industry average EPD the following additional items are required:
  - in order to evaluate the consistency of results between product specific EPDs and industry average EPDs either:



- the same LCA modeling software and version and background data shall be used to create the EPD; or
- the LCA modeling software and version shall test representative samples of the regionally specific industry average benchmark data and include in the EPD a report of the maximum percent difference for environmental impact categories: global warming potential, acidification potential, ozone depletion potential and smog creation potential. If a different LCA tool is selected, it shall be used to calculate environmental indicators for a sample of representative mixes taken from the published industry average LCA report. The variation of results produced by the selected LCA modeling software and version, compared to the published environmental indicators in the industry EPD shall be reported as a maximum percent variation for GWP 100, AP, EP or POCP. This is to provide transparency on the variability of results that stem from background data and models.
- an EPD shall be recalculated when changes to manufacturing practices are reasonably expected to result in a significant change to the EPD results;
- an EPD shall be recalculated when its period of validity is complete or when updates to the PCR result in significant changes to the EPD results;
- significant changes are an increase or decrease of GWP 100, AP, EP or POCP by more than 5% of previously reported result.



## 12 REFERENCES

### ASTM Standards<sup>2</sup>

ASTM A36/A36M, *Standard Specification for Carbon Structural Steel*

ASTM A108, *Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished*

ASTM A123/A123M, *Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*

ASTM A153/A153M, *Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*

ASTM A184, *Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement*

ASTM A307, *Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength*

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<sup>2</sup> ASTM International. 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. <[www.astm.org](http://www.astm.org)>





ASTM A416/A416M, *Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete*

ASTM A555/A555M, *Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods*

ASTM A615/A615M, *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement*

ASTM A666, *Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar*

ASTM A706/A706M, *Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement*

ASTM A767/A767M, *Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement*

ASTM A775/A775M, *Standard Specification for Epoxy-Coated Steel Reinforcing Bars*

ASTM A820/A820M, *Standard Specification for Steel Fibers for Fiber-Reinforced Concrete*

ASTM A884/A884M, *Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement*

ASTM A934/A934M, *Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars*

ASTM A1064/A1064M, *Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete*

ASTM C33/C33M, *Standard Specification for Concrete Aggregates*

ASTM C94, *Standard Specification for Ready-Mixed Concrete*

ASTM C150/C150M, *Standard Specification for Portland Cement*

ASTM C260/C260M, *Standard Specification for Air-Entraining Admixtures for Concrete*

ASTM C330/C330M, *Standard Specification for Lightweight Aggregates for Structural Concrete*

ASTM C494/C494M, *Standard Specification for Chemical Admixtures for Concrete*

ASTM C595, *Standard Specification for Blended Hydraulic Cements*

ASTM C618, *Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete*

ASTM C979/C979M, *Standard Specification for Pigments for Integrally Colored Concrete*

ASTM C989/C989M, *Standard Specification for Slag Cement for Use in Concrete and Mortars*

ASTM C1017/C1017M, *Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete*

ASTM C1116/C1116M, *Standard Specification for Fiber-Reinforced Concrete*

ASTM C1157/C1157M, *Standard Performance Specification for Hydraulic Cement*

ASTM C1240, *Standard Specification for Silica Fume Used in Cementitious Mixtures*

ASTM C1602/C1602M, *Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete*

ASTM G109, *Standard Test Method for Determining Effects of Chemical Admixtures on Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments*



### **CSA Standards<sup>3</sup>**

CAN/CGSB-1.40, *Anticorrosive Structural Steel Alkyd Primer*

CAN/CSA A23.1/A23.2, *Concrete Materials and Methods of Concrete Construction/Test methods and Standard Practices for Concrete*

CAN/CSA A23.4, *Precast concrete – Materials and construction*

CAN/CSA A3000, *Cementitious Materials Compendium*

CAN/CSA G30.18, *Carbon steel bars for concrete reinforcement*

CAN/CSA G40.20/G40.21, *General requirements for rolled or welded structural quality steel / Structural quality steel*

CSA S806, *Design and construction of building structures with fibre-reinforced polymers*

### **ISO Standards<sup>4</sup>**

ISO 6707-1: 2014, *Buildings and Civil Engineering Works – Vocabulary – Part 1: General Terms*

ISO 14021:1999, *Environmental Labels and Declarations – Self-declared Environmental Claims (Type II Environmental Labeling)*

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, *Environmental Management – Life Cycle Assessment – Requirements and Guidelines*

ISO 14067:2018, *Greenhouse Gases – Carbon Footprint of Products – Requirements and Guidelines for Quantification*

ISO 14050:2009, *Environmental Management – Vocabulary*

ISO 21930:2017, *Sustainability in Building Construction – Environmental Declaration of Building Products*

### **EN Standards<sup>5</sup>**

EN 16757, *Sustainability of construction works – Environmental product declarations – Product Category Rules for concrete and concrete elements*

EN 15804, *Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products*

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<sup>3</sup> CSA Group. 178 Rexdale Boulevard, Toronto, ON M9W 1R3, Canada. <[www.csa.ca](http://www.csa.ca)>

<sup>4</sup> International Organization for Standardization. Chemin de Blandonnet 8, Case Postale 401, 1214 Vernier, Geneva, Switzerland. <[www.iso.org](http://www.iso.org)>

<sup>5</sup> European Committee for Standardization. Rue de la Science 23, B-1040 Brussels, Belgium. <[www.cen.eu.com](http://www.cen.eu.com)>



### Other references

ACI 318-14, *Building Code Requirements for Structural Concrete and Commentary*<sup>6</sup>

Mather, B & Ozyildirim, C. (2002). SP-1(02) : Concrete Primer. American Concrete Institute : SP102.<sup>6</sup>

USGBC LEED v4 for Building Design and Construction, 11 Jan 2019 available at <[www.usgbc.org/resources/pcr-committee-process-resources-part-b](http://www.usgbc.org/resources/pcr-committee-process-resources-part-b)><sup>7</sup>

USGBC PCR Committee Process & Resources: Part B, USGBC, 7 July 2017 available at <[www.usgbc.org/resources/pcr-committee-process-resources-part-b](http://www.usgbc.org/resources/pcr-committee-process-resources-part-b)><sup>7</sup>

Product Category Rules for Preparing an Environmental Product Declaration for Precast Concrete (UN CPC 37550), ASTM International, March 2015.

<[www.astm.org/CERTIFICATION/DOCS/266.PCR\\_for\\_Precast\\_Concrete.pdf](http://www.astm.org/CERTIFICATION/DOCS/266.PCR_for_Precast_Concrete.pdf)><sup>2</sup>

Product Category Rules for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements, ASTM International, September 2014. <[www.astm.org/CERTIFICATION/filtrexx40.cgi?-P+PROG+7+cert\\_detail.fm](http://www.astm.org/CERTIFICATION/filtrexx40.cgi?-P+PROG+7+cert_detail.fm)><sup>2</sup>

US EPA *Waste Reduction Model (WARM)* – Fly Ash Chapter:

<<http://epa.gov/climatechange/wycd/waste/downloads/fly-ash-chapter10-28-10.pdf>><sup>8</sup>

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<sup>6</sup> American Concrete Institute. 38800 Country Club Drive, Farmington Hills, MI 48331. <[www.concrete.org](http://www.concrete.org)>

<sup>7</sup> US Green Building Council. 2101 L Street NW, Washington, DC 20037. <[www.usgbc.org](http://www.usgbc.org)>

<sup>8</sup> US Environmental Protection Agency. 1200 Pennsylvania Avenue NW, Washington, DC 20004. <[www.epa.gov](http://www.epa.gov)>



## APPENDIX A: DEFAULT DATA SOURCES

The default LCA/LCI data noted in Table A-1 of this appendix shall be used unless manufacturer and product specific EPD results are available. Tables A-2 and A-3 shall be used for all applications unless an alternate standardized regional database is published as a clarification to the *PCR for Concrete* to enable more accurate yet still standardized upstream LCA data.

In order to align with EN 16757 and provide greater clarity on developing methodology, the following characterization factors are defined in Table A-4. Per EN 16757:2017 Annex C, “this is a conservative approach coming from the fact that it is difficult to analyze the chemical composition of sand or gravel. As characterization factor of calcium is zero, it uses the assumption that the material consists of silicon only.”

**Table A-1**  
**Material data**

Materials		Default LCA / LCI data	Year Region	PCR
Cements	Portland cement	<p>Manufacturer product specific cement EPD is preferred and should be used when they exist.</p> <p>When cement manufacturer product specific is not available the appropriate industry wide EPDs listed below may be used.</p>	North America	<p>NSF International <i>Product Category Rule for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements</i>, v3.1, September 2020, found at  <a href="http://www.astm.org/CERTIFICATION/EpdAndPCRs.html">www.astm.org/CERTIFICATION/EpdAndPCRs.html</a></p>
	blended hydraulic cements	<p>Portland Cement Association EPDs with ASTM as program operator, found at:  <a href="http://www.astm.org/CERTIFICATION/EpdAndPCRs.html">www.astm.org/CERTIFICATION/EpdAndPCRs.html</a></p> <p>— EPD for Portland cements – Industry wide;</p>	<p>ASTM 2021</p> <p>Unless a more recent version is published, then it shall be used</p> <p>CSA 2015</p>	





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**Table A-1**  
**Material data**

Materials		Default LCA / LCI data	Year Region	PCR
	performance-based hydraulic cement	<ul style="list-style-type: none"> <li>— EPD for Portland limestone cements – Industry wide; and</li> <li>— EPD for Blended hydraulic cements – Industry wide.</li> </ul>	Unless a more recent version is published, then it shall be used	
	Portland-limestone cement	<p>Cement Association of Canada EPDs with CSA as program operator found at: <a href="http://www.astm.org/CERTIFICATION/EpdAndPCRs.html">www.astm.org/CERTIFICATION/EpdAndPCRs.html</a></p> <ul style="list-style-type: none"> <li>— general use (GU) and Portland limestone (GUL) cements.</li> </ul> <p>When using cement produced anywhere outside of North America, reference applicable EPD options referenced above.</p>		
Aggregates	fine aggregate – crushed	Ecoinvent 3.4: “Gravel, crushed {RoW}  production   Alloc Rec”	2001	<p><i>PCR for Construction Aggregates: Natural Aggregate, Crushed Concrete and Iron/Steel Furnace Slag</i></p> <p><a href="http://www.astm.org/CERTIFICATION/DOCS/369.PCR_for_Construction_Aggregates_PCR.pdf">www.astm.org/CERTIFICATION/DOCS/369.PCR_for_Construction_Aggregates_PCR.pdf</a></p> <p>Note – When using Ecoinvent dataset, replace electricity with US data and follow allocation approach outlined in Aggregate PCR.</p>
	coarse aggregate – crushed		World	
	fine aggregate – natural sand	Ecoinvent 3.4: “Gravel, round {RoW}  gravel and sand quarry operation   Alloc Rec”	2001	
	coarse aggregate – natural gravel		World	
	lightweight aggregates	Ecoinvent 3.4: “Expanded clay {RoW}  production   Alloc Rec”	2000 World	
SCMs	supplementary cementitious materials (SCMs) – fly ash	N/A recovered material, per PCR	N/A	None





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**Table A-1**  
**Material data**

Materials		Default LCA / LCI data	Year Region	PCR
	SCMs – silica fume	N/A recovered material, per PCR	N/A	None
	SCMs – Ground granulated blast furnace slag cement	Slag Cement Association EPD with ASTM as program operator, found at <a href="http://www.astm.org/CERTIFICATION/EpdAndPCRs.html">www.astm.org/CERTIFICATION/EpdAndPCRs.html</a>  — EPD for Slag Cement – Industry Wide EPD  *SCA EPD will be updated in 2021 at ASTM site listed. 2015 EPD should no longer be used once it has been removed from ASTM site.	2015* 2021  Unless a more recent version is published, then it shall be used  North America	NSF International PCR for Slag Cement v2.0, December 2020 (UN CPC 3744 – Slag Cement) can be found at:  <a href="http://www.astm.org/CERTIFICATION/EpdAndPCRs.html">www.astm.org/CERTIFICATION/EpdAndPCRs.html</a>
Water	water	Ecoinvent 3.4: Tap water {RoW}  market for   Cut-off adjusted for the electricity grid for the region of interest.  If water source includes significant fresh water created via desalination processes, the tap water LCI shall be supplemented with regionally specific LCI of water and the LCI source specified in the EPD.	N/A	None
Admixtures	chemical admixtures	European Federation of Concrete Admixtures Associations (EFCA) EPDs  <a href="http://www.efca.info/efca-publications/environmental/">www.efca.info/efca-publications/environmental/</a>  NOTE — If EFCA EPD does not exist for a specific admixture, use the EPD results for water reducing admixture or a product specific EPD developed by the product manufacturer.	2015  Unless a recent version has been published, then it shall be used  Europe	IBU EPD for Admixtures
	chemical admixture – plasticizer			
	chemical admixture – coloring			



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**Table A-2  
Transportation data**

Transportation mode		Default LCI data	Year Region	Notes
Land	road: combination truck	“Transport, combination truck, long-haul, diesel powered / tkm / RNA”	2010 USA	
		“Transport, combination truck, short-haul, diesel powered / tkm / RNA”		
	road: single unit truck	“Transport, combination truck, short-haul, gasoline powered / tkm / RNA”		
		“Transport, single unit truck, long-haul, diesel powered / tkm / RNA”		
road: single unit truck	“Transport, single unit truck, long-haul, gasoline powered / tkm / RNA”	2010 USA		
	“Transport, single unit truck, short-haul, diesel powered / tkm / RNA”			
rail		“Transport, single unit truck, short-haul, gasoline powered / tkm / RNA”	2007 USA	
		“Transport, train, diesel powered / tkm / US”		
Water	freighter	“Transport, train, diesel powered / tkm / US”	2007 USA	
		“Transport, ocean freighter, average fuel mix / tkm / US”		
	barge	“Transport, barge, average fuel mix”	2007 USA	
		“Transport, barge, diesel powered”		
		2003 USA		



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**Table A-3  
Energy data**

Energy source	Default LCI data	Year Region	Notes
Electricity generation	Ecoinvent 3.4 electricity processes by NERC Region	2015 USA	
Site energy	US Life Cycle Inventory Database (NREL): “Natural gas, combusted in industrial boiler / US” “Residual fuel oil, combusted in industrial boiler / US” “Diesel, combusted in industrial equipment/US” “Gasoline, combusted in equipment/US”	2007 USA	



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**Table A-4**  
**Additional characterization factors for ADP**  
(per EN 16757:2017)

Substance	Unit	Group	Initial emission or extraction	Characterization factor kg antimony eq.	Comment
clay	kg	element	resources	1.4E-11	assimilated to silicon
bentonite	kg	element	resources	1.4E-11	assimilated to clay
limestone	kg	element	resources	0	assimilated to calcium
gravel (unspecified)	kg	element	resources	1.4E-11	assimilated to silicon
silica (SiO <sub>2</sub> )	kg	element	resources	1.4E-11	assimilated to silicon
sand (unspecified)	kg	element	resources	1.4E-11	assimilated to silicon



## APPENDIX B: TECHNICAL REVIEW COMMITTEE

The following individuals participated in the review committee from June 2019 through March 2020:

### **Manufacturers**

Hamid Farzam, Cemex

Shawn Kalyn, Votorantim / St. Marys Cement LLC

Kirk McDonald, CalPortland

Adam Swercheck, Heidelberg Technology Center

Cheng Qi, Ash Grove Cement / CRH

### **Trade Associations**

Adam Auer, Cement Association of Canada

Jamie Farny, Portland Cement Association

### **Users**

James Bogdan, National Ready Mixed Concrete Association

David Green, BASF Corp.

Emily Lorenz, Precast / Prestressed Concrete Institute

Martha VanGeem, Consultant

### **LCA Expertise**

Jamie Meil, ATHENA Sustainable Materials Institute

Eric Masanet, Northwestern University

### **NSF International**

Andrea Burr