NATIONAL CONCRETE CONSORTIUM

"Moving Advancements into Practice"

MAP Brief Fall 2024

Best practices and promising technologies that can be used now to enhance concrete paving

Understanding Environmental Product Declarations (EPDs)

FALL 2024

PROJECT TITLE
Understanding Environmental Product Declarations (EPDs)

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Introduction

Environmental Product Declarations (EPDs) have become increasingly important tools for federal, state, and local government agencies aiming to reduce embodied carbon emissions and make informed decisions throughout the project delivery process.

EPDs offer a clear way to report the upfront embodied greenhouse gas (GHG) emissions of construction materials, thus allowing agencies to significantly reduce adverse environmental effects and promote sustainability by integrating EPDs into the project delivery workflow. This MAP brief focuses on the development and use of EPDs for concrete mixtures.

What is an EPD?

An EPD is a transparent, independently verified report that communicates the upfront embodied environmental impacts associated with construction materials, including cement and concrete mixtures. These impacts are assessed in terms of resource use, energy consumption, and emissions generated during raw material extraction and the transportation and production of these materials.

Often referred to as a nutrition label for materials or products, EPDs report environmental impacts instead of nutritional content like sodium or carbohydrates. These impacts include factors such as global warming potential (GWP), eutrophication potential, acidification potential, and several others. Given the current societal focus on climate change and carbon reduction, GWP is the most commonly used metric. Figure 1 shows a sample EPD for concrete.

Scope of EPDs

EPDs can vary significantly depending on the life-cycle stages they cover. The most commonly used EPD type at this time is cradle-to-gate. This is due to the current limitations of product category rules (PCRs), a lack of consensus-based models for further life-cycle stages, and data availability. That being said, substantial work is ongoing in industry, academia, and agencies to quantify and report emissions stemming from phases beyond the gate. The Reduced Carbon Concrete Consortium (RC3) further details the use of EPDs in pavement decision-making in Ferrebee and Van Dam (2024).

Cradle-to-Gate EPDs

These EPDs report the environmental impacts from raw material extraction (cradle) to the point where the product leaves the production facility (gate). They do not include impacts from the use phase or end-of-life disposal.

ENVIRONMENTAL IMPACTS

Declared Product:
Description: Exterior 4000 psi
Compressive strength: 4000 psi at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	318
Ozone Depletion Potential (kg CFC-11-eq)	7.15E-6
Acidification Potential (kg SO_2-eq)	0.95
Eutrophication Potential (kg N-eq)	0.24
Photochemical Ozone Creation Potential (kg O_3-eq)	20.7
Abiotic Depletion, non-fossil (kg Sb-eq)	5.82E-5
Abiotic Depletion, fossil (MJ)	658
Total Waste Disposed (kg)	94.2
Consumption of Freshwater (m^3)	2.40

Product Components: natural aggregate (ASTM C33), portland cement (ASTM C150), fly ash (ASTM C618), batch water (ASTM C1602), admixture (ASTM C494), admixture (ASTM C260)

Recreated from FHWA 2022

Figure 1. Sample concrete EPD

As these EPDs do not consider the construction, use, or end-of-life phases of a material, a significant portion of emissions are unaccounted for in cradle-to-gate EPDs.

Per the current concrete PCR, most concrete EPDs cover only cradle-to-gate impacts, or A1 to A3. However, the concrete PCR does allow for the optional reporting of the construction stage, which includes A4 (Transport to Site) and A5 (Installation). Refer to Figure 2.

Cradle-to-Built or Site EPDs

These EPDs include the impacts from the cradle-to-gate EPDs in addition to the impacts from transportation to the paving site and the construction operation emissions from paving.

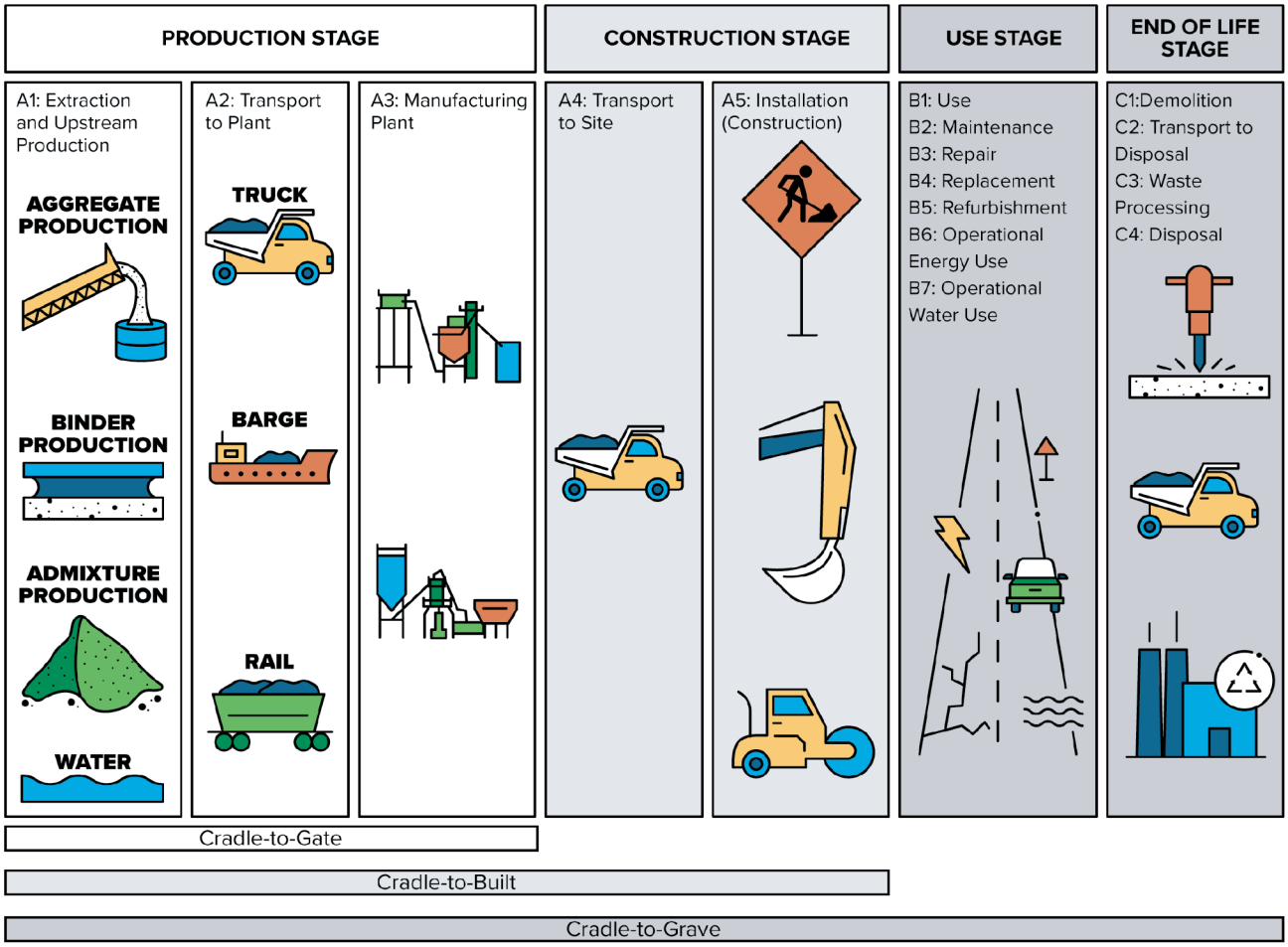
Cradle-to-Grave EPDs

These EPDs provide a comprehensive assessment that includes all stages: from raw material extraction through production, construction, use, and end-of-life disposal.

While in Europe countries have these EPDs, it is important to note than in the United States we still have not seen this type of EPD. The Federal Highway Administration (FHWA) Sustainable Pavements Program along with other relevant stakeholders are working towards establishing the needed information to create this type of EPD in the United States.

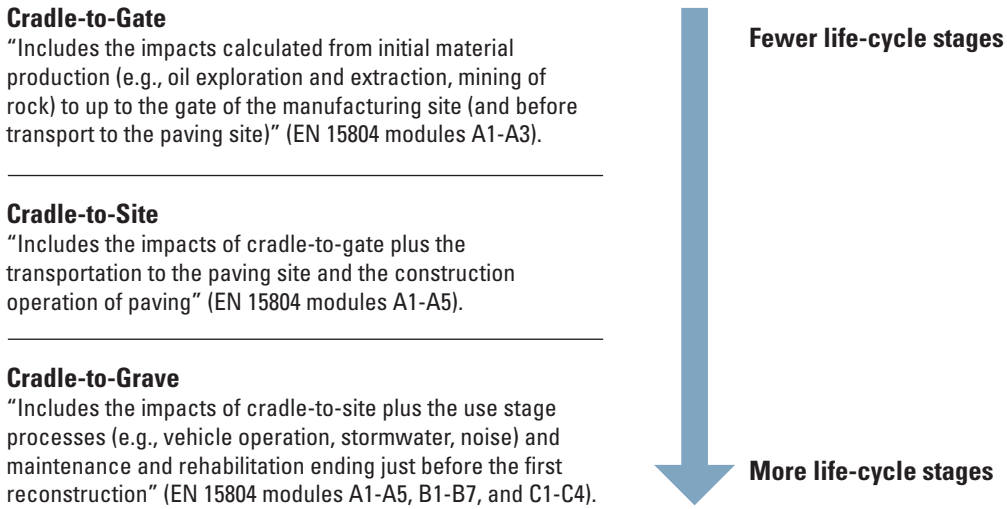
Figure 3 defines the various impacts with respect to the number of life-cycle stages.

EPDs can also differ in their level of specificity, providing varying degrees of detail and applicability. Figure 4 illustrates EPD applicability with respect to specificity levels.



FHWA 2024

Figure 2. Life-cycle stages of asphalt/concrete pavement systems



Recreated from FHWA 2021

Figure 3. Relationship of impacts to number of life-cycle stages

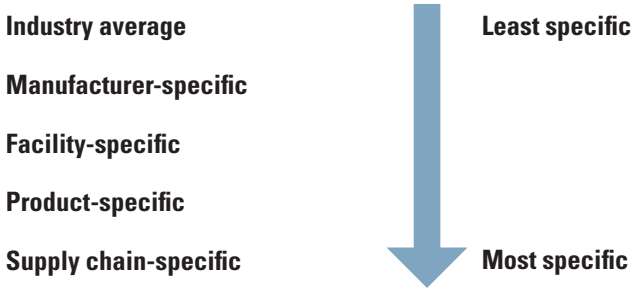


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Figure 4. EPD applicability—specificity relationship

The following are various EPD applications:

- *Industry average EPDs:* These are generic EPDs that represent the average environmental impacts for a specific product category within an industry.
- *Manufacturer-specific EPDs:* These EPDs represent a group of materials or products that fulfill the same or similar function, have similar manufacturing processes, and have similar environmental impact results. This type of EPD allows for manufacturers to average the production-weighted environmental impacts across multiple facilities.
- *Facility-specific EPDs:* These EPDs report the average environmental impacts of products produced at a specific manufacturing facility.
- *Product-specific EPDs:* These EPDs provide detailed environmental data for a specific product, accounting for the unique attributes and manufacturing processes associated with that product.
- *Supply chain-specific EPDs:* These EPDs delve into the environmental impacts associated with specific supply chains, including raw material sourcing, transportation, and production processes. For example, a supply chain-specific concrete EPD would use facility- and product-specific cement data.

How are EPDs Developed?

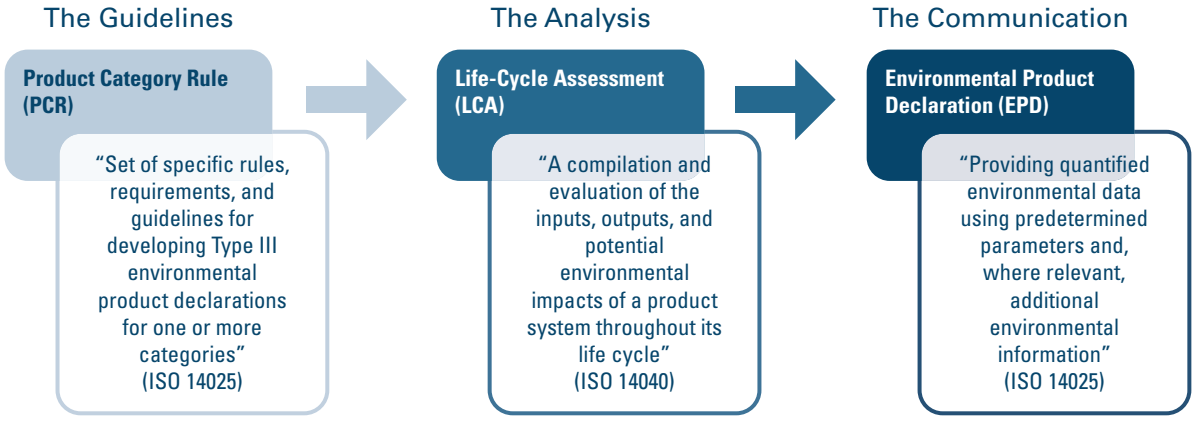
EPDs are developed using a life-cycle assessment (LCA) methodology and are based on a document called a PCR. Figure 5 illustrates the relationship between a PCR, LCA, and EPD.

Development or Selection of PCR

A PCR is a set of guidelines, requirements, and rules for creating EPDs for one or more product categories. PCRs are used to define the requirements for conducting LCA studies and summarizing the results in EPDs. PCRs include items such as system boundaries, allocation methods, prescriptive data sources, and the declared or functional unit for the product category.

A PCR program operator is an independent entity that creates PCRs and coordinates stakeholders to ensure that they adhere to standards established by the International Organization for Standardization (ISO).

PCRs are developed openly and collaboratively, similar to industry standards, and may include stakeholders such as manufacturers, material suppliers, and consumers.



Recreated from Johnson et al. 2023

Figure 5. Relationship between PCR, LCA, and EPD

Supplier Data Collection and LCA

With the increased demand for transparency in construction materials and products, multiple software tools have been developed to minimize the time, cost, and resources required to develop EPDs. These software tools require the supplier or manufacturing organization to collect data and enter them into the software. In the absence of a custom software tool, an LCA can also be performed by an LCA practitioner.

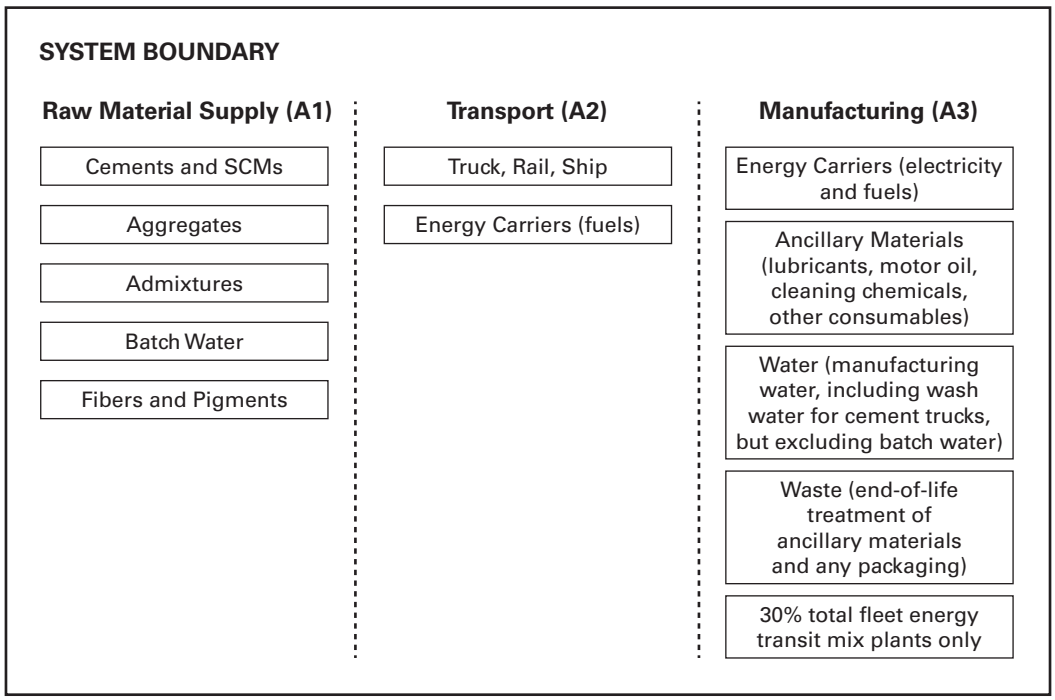
The data required include, but are not limited to, raw material use, transportation distances and modes, facility energy and fuel consumption, and production volumes. Figure 6 shows an example LCA for a cradle-to-gate EPD.

Develop EPD

Once the LCA is performed, EPD development may commence. EPDs must report the LCA results in the format defined in the PCR.

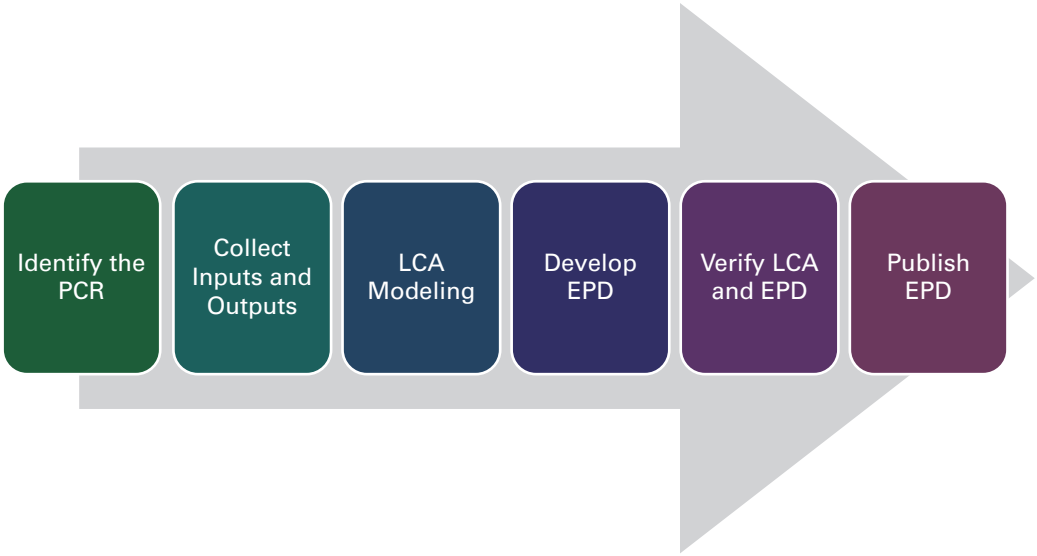
Third-Party Verification and Publication

Once the draft EPD is developed, it must be reviewed by an independent third-party or program operator to verify compliance of the EPD with the PCR. The program operator will publish the verified EPD after the third-party review process is completed successfully. Figure 7 illustrates the EPD development process.



Recreated from NSF Concrete PCR 2021

Figure 6. Concrete LCA example



Adapted from Ahuja, NGA Fall 2018 Conference

Figure 7. EPD development process

How are EPDs Used?

Agencies, suppliers, and manufacturers may use EPDs for the following:

- Transparent communication
- Marketing for sustainability initiatives
- Meeting of state or federal specifications or requirements
- Benchmarking of current environmental performance at the material, project, or network level
- Reduction of embodied emissions of construction materials used in projects
- Procurement aid at the time of bidding

Important Notes

Comparisons of different EPDs can only be made if the performance of the compared materials is functionally equivalent and if the EPDs were developed under the same PCR. As such, EPDs should not be used to compare asphalt and concrete or to compare materials that are not required to meet the same specifications or performance criteria.

Additionally, the collection and use of EPDs should not be a justification for not meeting performance or service life requirements.

State of Practice

Federal Efforts

- FHWA Sustainable Pavements Program
- FHWA Climate Challenge
- FHWA Low-Carbon Transportation Materials (LCTM) Program & Grant
- Every Day Counts Round 7 (EDC-7) - EPDs for Sustainable Project Delivery
- LCA Pave Tool
- Environmental Protection Agency (EPA) Funding via the Inflation Reduction Act (IRA)
- U.S. General Services Administration (GSA) Low Embodied Carbon Program

State Legislation

- California: The California Department of Transportation started requesting EPDs for eligible materials in 2019 and requiring EPDs for those materials beginning in January 2020 as part of the Buy Clean California Act (California Legislative Organization 2017).
- Oregon: The Oregon Department of Environmental Quality has a voluntary program to help concrete mix manufacturers produce EPDs, aiming to reduce the environmental impact of concrete consumed in Oregon (OCAPA and Oregon DEQ 2016).
- Other States: States including Colorado and Minnesota have also passed legislation requiring the collection and use of EPDs. Additionally, many agencies have elected to develop programs to collect and use EPDs without legislative mandates.

Case Study (Colorado Department of Transportation)

House Bill 21-1303, or the Buy Clean Colorado Act, was passed in 2021. It required the Colorado Department of Transportation (CDOT) to collect EPDs on cement and concrete mixtures, asphalt and asphalt mixtures, and steel as of July 2022. The legislation also required that CDOT develop a policy setting maximum GWP limits by January 1, 2025.

CDOT has been collecting EPDs for eligible materials and projects since July 2022 and is using the EPDs to benchmark current environmental performance. It is performing extensive data analysis and industry outreach to ensure that the limits set will be reasonable and will represent the materials being placed on CDOT projects. The legislation allows CDOT to review and adjust its policy every four years, but once limits are set, they cannot be made less stringent for any material.

From its inception, CDOT's EPD program has prioritized open and frequent communication with stakeholders, including industry associations, contractors and local suppliers, project personnel, and other agencies. In an attempt to limit undue burden on small suppliers and contractors, CDOT has also established quantity thresholds and project material cost limits under which EPDs are not required.

Challenges and Opportunities

While the current development and use of EPDs has room for improvement, there are many exciting opportunities available to enhance the current state of practice. Some of these opportunities are outlined below:

- Improvements to the concrete PCR, EPD reporting requirements, and data accuracy are underway. Additionally, work is being done to harmonize PCRs and agency policies.
- Communication gaps with stakeholders are being addressed by increasing communication and collaboration at the federal, state, and local levels.
- The Inflation Reduction Act provides funding for industry partners, suppliers, and agencies. This funding has the potential to reduce the burden of EPD development on suppliers as well as provide agencies an outlet to create more robust implementation programs.
- Many software tools and digital EPD repositories are being introduced. These have the potential to simplify the EPD submission and verification process.

Resources

Carbon Leadership Forum (CLF) Embodied Carbon Policy Toolkit: https://carbonleadershipforum.org/clf-policy-toolkit/#map

CP Tech Center Reduced-Carbon Concrete webpage: https://cptechcenter.org/reduced-carbon-concrete/

FHWA Sustainable Pavements Program: https://www.fhwa.dot.gov/pavement/sustainability/

National Ready Mixed Concrete Association (NRMCA) EPD webpage: https://www.nrmca.org/association-resources/sustainability/environmental-product-declarations/

Tech Brief: Environmental Product Declarations; Communicating Environmental Impact for Transportation Products: https://www.fhwa.dot.gov/pavement/sustainability/hif21025.pdf

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