

TECH BRIEF: ENVIRONMENTAL PRODUCT DECLARATIONS

Communicating Environmental Impact for Transportation Products

State Departments of Transportation (DOTs) are continually assessing and choosing materials or technologies to meet their transportation needs. As part of this assessment, DOTs are turning to Environmental Product Declarations (EPDs) to quantify the environmental impacts associated with those products.

What Are Environmental Product Declarations?

An Environmental Product Declaration (EPD) is a transparent, verified report used to communicate the environmental impact (e.g., resource use, energy, emissions) associated with the manufacture or production of construction materials such as asphalt, cement, asphalt mixtures, concrete mixtures, or steel reinforcement. EPDs, also called Type III Environmental Declarations, are product labels developed by industry in accordance with International Organization for Standardization (ISO) Standard 14025. ISO Standard 14025 includes a critical review process to ensure that the ISO standards and the industry consensus standards described in the Product Category Rule (PCR) document were followed.

EPDs and PCRs are not required by law or Federal regulation.

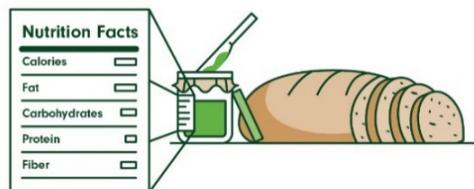
What Are the Benefits of EPDs?

- Provide verifiable and transparent information on life-cycle environmental impact data for materials or products.
- Allow meaningful comparisons of the environmental performance of materials (if they were developed using the same product category rules, PCRs, which are industry consensus standards and guidelines used in developing and reporting EPDs).
- Identify areas for environmental performance improvement, encouraging industry efficiency.

Table 1. Environmental impacts reported in an EPD for an asphalt mix design (based on a hypothetical scenario from National Asphalt Pavement Association).

TRACI Impact Indicator	Unit	Materials	Transport	Production
Global Warming Potential	kg CO ₂ -Equiv.	83.4	11.8	168
Ozone Depletion	kg CFC-11-Equiv.	1.81e-08	5e-10	8.55e-11
Acidification	kg SO ₂ -Equiv.	0.486	0.0577	1.08
Eutrophication	kg N-Equiv.	0.0263	0.00373	0.0207
Smog Air	kg O ₃ -Equiv.	8.23	1.81	13.3

Note: Impacts for Test Mix 1, a dense-graded Superpave asphalt mixture, categorized as a hot-mix asphalt mixture, produced within a temperature range of 100 to 250°F.



Similar to nutrition labels for food products, EPDs communicate critical environmental information on pavement materials to the customer.

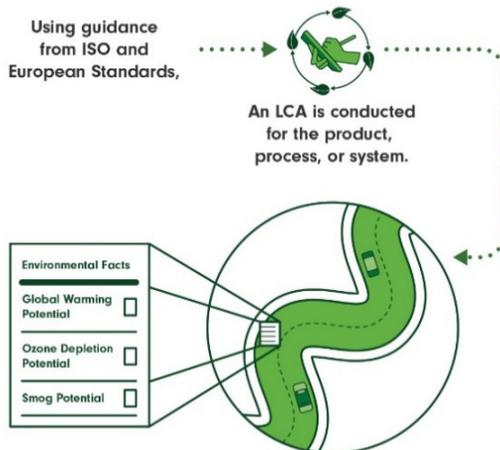


Figure 1. EPD concepts.

How Are EPDs Used?

- **Green Procurement.** An EPD encourages the demand for (and supply of) those products that promote the more sustainable use of finite resources and that create less stress on the environment.
- **Environmental Stewardship.** An EPD is a statement that the manufacturer is paying attention to the environmental aspects of sustainability.
- **Progress Measurement.** Periodic updating of EPDs can show the progress being made by a manufacturer or an industry. Agencies can use this information to track supplier progress in meeting agency goals.
- **Pavement Design.** EPDs provide critical information for use in conceptual- and project-level full (i.e., cradle-to-cradle) LCAs or less rigorous types of environmental assessment of alternative design decisions.
- **Pavement Management.** Industry-average EPD data can be included in databases used in pavement management systems to perform network-level LCA.

How Are EPDs Produced?

The production of an EPD consists of four basic steps defined and required by the ISO 14025 standards.

Step 1: Developing the PCR

EPDs are developed using industry standards defined in a PCR document. PCRs are developed by a committee of stakeholders convened by a program operator, which can be a company or a group of companies, an industrial sector, or a trade association. In the U.S., most program operators are accredited certification bodies or industry organizations for a given product (e.g., [National Ready Mix Concrete Association](#), [National Asphalt Pavement Association](#)).

An open consultation process is followed to gather input on the draft PCR from the following stakeholders:

- Internal stakeholders within the industry, including individual manufacturers.
- Competing industries.
- LCA practitioners.
- Subject matter experts, often from academia.
- Government agencies.
- Non-governmental organizations.
- Customers.

A third-party independent review panel, typically with at least three members and including both LCA experts and subject matter experts, reviews the PCR for logic and compliance with ISO 14025 and other standards of importance to customers. A common standard of importance for pavements is ISO 21930, which is more specific to civil building materials. The PCR is reviewed and revised until the independent review team agrees that it meets the requirements of the standards it states that it meets and is otherwise practical and reasonable.

Step 2: Developing the LCA for the EPD

To publish an EPD, an LCA is developed for the PCR's product or group of products. The LCA follows the instructions in the pertinent PCR for these items:

- **Product definition**, in terms of function, technical performance, and use.
- **Goal and scope**, including functional and declared units for a product, system boundaries, description of data, completeness criteria for inclusion of inputs and outputs, and data quality requirements.

- **Data aspects**, such as requirements and guidelines for data collection, calculation procedures, and allocation of material and energy flows and releases.
- **Environmental impacts**, featuring the selection of impact categories and impact calculation rules to be used in the LCA.
- **Requirements and guidelines**, to be followed for producing data used to compile and quantify product inputs and outputs for the entire life cycle.
- **Reporting**, including the method for presenting and formatting the results.

Any party that produces a product or group of products can develop an EPD based on a published PCR. An industry group will often perform an initial national industry-average or regional-average LCA that uses typical national or regional values following the PCR. That initial LCA assembles all the information needed for product manufacturers to produce initial EPDs. The initial national or regional EPD provides information that makes it easier for individual companies to produce EPDs for their company or for plant-specific products by adjusting the formulation (concrete or asphalt mix design, for example) and making other changes needed to make the EPD relevant to their specific product.

Step 3: Developing the EPD

An EPD must comply with the necessary instructions from the relevant PCR. The PCR ensures that the EPDs will not only use the results of the LCA with defined content and format, but will also comply with the same requirements for any additional environmental information, including methodological requirements, inclusion of materials and substances to be declared, and period of validity. EPDs can only be produced for those stages of the life for which the EPD developer has information, typically (see figure 3):

- **Cradle-to-Gate**. Includes the impacts calculated from initial material production (e.g., oil exploration and extraction, mining of rock) up to the gate of the manufacturing site (and before transport to the paving site) (EN15804 modules A1-A3).
- **Cradle-to-Site**. Includes the impacts of cradle-to-gate plus the transportation to the paving site, and the construction operation of paving (EN15804 modules A1-A5).
- **Cradle-to-Grave**. Includes the impacts of cradle-to-site, plus the use stage processes (e.g., vehicle operation, stormwater, noise) and maintenance and rehabilitation ending just before the first reconstruction (EN15804 modules A1-A5, B1-B7, and C1-C4).

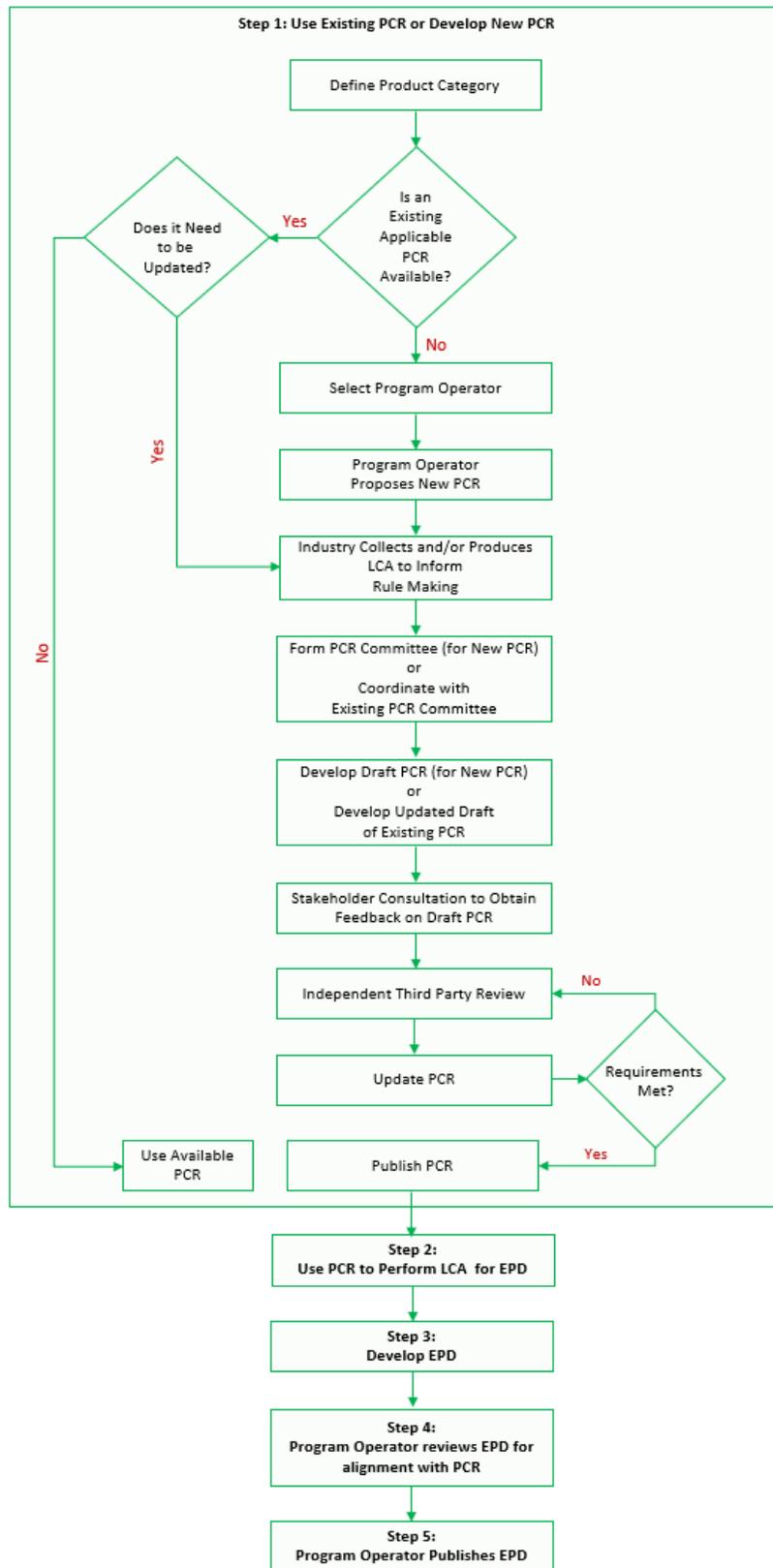


Figure 2. Steps in the development of EPDs.

Table 2. Life-cycle stages included in EPDs applied to pavement LCA (based on data from EN15804).

EN 15804 Module	Life Cycle Stage	Process	EN 15804 Module #	Cradle-to-Gate EPD	Cradle-to-Gate EPD with options	Cradle-to-Site EPD	Cradle-to-Grave EPD
EN 15804 Module A	 Product Stage	Raw Material Supply	A1	X	X	X	X
		Transport	A2	X	X	X	X
		Manufacturing	A3	X	X	X	X
	 Construction Process Stage	Transport	A4	-	O	X	X
		Construction	A5	-	O	X	X
EN 15804 Module B	 Use Stage	Use	B1	-	O	-	X
		Maintenance	B2	-	O	-	X
		Repair	B3	-	O	-	X
		Replacement	B4	-	O	-	X
		Refurbishment	B5	-	O	-	X
		Operational energy use	B6	-	O	-	X
		Operational water use	B7	-	O	-	X
EN 15804 Module C	 End-of-Life Stage	Demolition	C1	-	O	-	X
		Transport	C2	-	O	-	X
		Wastage processing	C3	-	O	-	X
		Disposal	C4	-	O	-	X

X = Mandatory O = Optional - = n/a

Step 4: Publishing the EPD

A neutral third party or the program operator must verify the EPD as being compliant with the PCR. While ISO 14025 has defined specific requirements for PCR review and EPD verification, ISO itself does not review the credentials of critical reviewers or enforce any standards. Instead, it is assumed that if the critical reviewers are not sufficiently qualified then consumers will not have faith in the EPD, and it will not be accepted. The program operator will issue the EPD after successful completion of the review process.

Current State of Practice

Several pavement materials industries (e.g., National Asphalt Pavement Association, Portland Cement Association) have developed (or are developing) PCRs and are operating EPD programs. At the same time, a number of supporting industries that provide admixtures and other ingredients are also working on developing EPD programs. The primary business incentive for industry to produce EPDs at this time is to gain points in rating systems such as in the LEED v4 framework, but highway agencies could also encourage their development by providing incentives.

The FHWA is developing a pavement LCA tool that will assist agencies in assessing, benchmarking, and communicating environmental impacts of pavement materials and designs.

Harmonization of PCRs

Because multiple components of a PCR apply broadly across different products and processes, harmonization of the PCRs is critical for EPDs to be of value as a data input for pavement LCAs or for public procurement.

Approaches being discussed include whether there should be a single PCR which would identify the common rules that apply across all products and processes for the U.S. and whether a governing consortium should be created. The [Program Operator Consortium](#) and the [American Center for Life Cycle Assessment](#) are two examples of recent initiatives working on these issues.

The FHWA is working on documenting best practices for developing PCRs for EPDs of pavement materials to aid the harmonization process.

How Can Agencies Use EPDs Today?

- Establish a database with EPDs relevant to pavements.
- Encourage the development and use of EPDs by providing incentives to industries or manufacturers.
- Compile EPDs to track and communicate the progress being made towards the agency's sustainability goals.
- Use average EPDs as inputs to the agency's use of LCA in pavement design, asset management, and in the development of specifications and policies.
- Conduct a pilot program to introduce the industry to EPDs and their applications.
- Participate as a stakeholder for creating PCRs (review or committee member) to ensure EPDs are produced in line with the public interests.
- Encourage the use of EPDs that have been created by PCRs that follow best practices to help ensure harmonization.
- Consider EPDs for materials procurement once harmonization efforts have created a sufficiently level playing field for competition.

How Are Agencies Encouraging EPDs?

- The [California Department of Transportation](#), as part of the Buy Clean California Act, is currently requesting EPDs for eligible materials and will require EPDs in 2020.
- Similar legislation requiring EPDs for public procurement has been proposed in several States, including Oregon, Minnesota, and Washington.
- [Oregon Department of Environmental Quality](#) has a voluntary program to help concrete mix manufacturers produce EPDs in aims to help reduce the environmental impact of concrete consumed in Oregon.
- In March 2018, Washington State Legislature authorized the University of Washington to conduct a [study](#) and the Department of Enterprise Services to conduct a pilot of the Buy Clean Washington Act to develop policy recommendations for how EPDs could be used for public purchasing in Washington State.

Special Considerations

- It is preferred to compare alternatives on a cradle-to-grave basis while demonstrating that the alternatives meet the same performance requirements. However, when any parts of the life cycle have been analyzed to be similar or equivalent, they may be left out. It is expected that EPDs for cradle-to-gate impacts will be by far the most prevalent type in the U.S. because this is the part of the life cycle controlled by the materials producer in the typical design-bid-build contracting environment. These EPDs should not be used for comparison between materials types or between materials of the same type unless their cradle to grave performance is expected to be similar.
- Cradle-to-gate EPDs can be used to report or benchmark an agency’s operations or to use the EPDs as input to LCA studies.
- A number of factors currently limit the use of EPDs as part of the procurement process.
 - Since most pavement material EPDs at this time are cradle-to-gate, procurement should focus on this stage for the foreseeable future. Further processing, transportation to the paving site, construction, performance in the use stage and consideration of end-of-life are not included.
 - There are issues with some of the upstream data that go into the development of the EPDs, which raises issues as to the validity of the results.
 - There are harmonization issues with some of the EPDs, which limits the ability to make direct comparisons between materials. Procurement should focus on incentives to improve impacts within a given class of material at this time.

Getting Started with EPDs

A three-stage implementation plan based on the results of an [FHWA-supported workshop on EPDs](#) is summarized below:

Stage 1: Reporting (1 to 2 years)

- Develop policies and reporting practices as a move toward standardization of EPDs.
- Use pilot projects for requesting EPDs to refine the specification for the EPDs and for using EPDs, including development of tools that use EPDs as inputs.

Stage 2: Standardization of PCRs (3 to 5 years)

- Work with other agencies and industries to push for harmonization of PCRs, and work to fill gaps in public databases.
- Implement incentives for providing plant-specific EPDs.
- Continue to improve the use of EPDs in pavement design and asset management.

Stage 3: Procurement (> 3 years)

- Consider using EPDs along with costs in selecting materials to meet given performance requirements in design-bid-build projects once sufficient progress has been made towards accounting for materials performance and improving the quality of EPDs.
- Consider EPDs for constructed pavement systems, or for longer-term maintenance and rehabilitation of a highway network as follows:
 - EPDs of materials (design-build).
 - EPDs of cradle-to-site for the project as opposed to individual materials (design-build).
 - EPDs of full life cycle for the project (design-build-maintain).

Where Can I Find EPDs?

[Sustainable Minds](#) has offered to establish an online catalog to which any organization can submit EPDs for listing. Industries that have published EPDs or are working toward the publication of one are listed in the table below.

Material	Source
Blended Cement	ASTM Slag Cement Association
Portland Cement	Portland Cement Association / ASTM
Steel	Concrete Reinforcing Steel Institute
Hot Mix Asphalt	National Asphalt Pavement Association
Concrete	National Ready Mixed Concrete Association
Aggregates	ASTM

Where Can I Learn More?

Some key resources that provide information on the various tools, techniques, and methodologies related to LCT are provided below. Additional information and resources can be found on the [sustainable pavements webpage](#).

- [FHWA Sustainable Pavements Reference Document \(FHWA-HIF-15-002\)](#).
- [FHWA Tech Brief on Pavement Life Cycle Assessment \(FHWA-HIF-15-001\)](#).
- [FHWA Tech Brief on Pavement Sustainability \(FHWA-HIF-14-012\)](#).
- [FHWA Pavement Life-Cycle Assessment Framework \(FHWA-HIF-16-014\)](#).
- FHWA Tech Brief on Life-Cycle Thinking

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