

# Sustainable Pavements Program Advancing the Practice



*Migdalia Carrion, Program Manager*

National Center for Pavement Preservation Conference  
September 19, 2023

# Disclaimer

Except for the statutes and regulations cited, the contents of this presentation do not have the force and effect of law and are not meant to bind the States or the public in any way. This presentation is intended only to provide information regarding existing requirements under the law or agency policies.

Unless otherwise noted, FHWA is the source for all images in this presentation.

# Acronyms

- EPD Environmental Product Declaration
- GGBFS Ground Granulated Blast Furnace Slag
- GWP Global Warming Potential
- LCA Life Cycle Assessment
- LCCA Life Cycle Cost Analysis
- M&R Maintenance and Rehabilitation
- MCTC Mobile Concrete Technology Center
- PCR Product Category Rules
- S-LCA Social Life Cycle Assessment
- SPP Sustainable Pavements Program

# Overview

- FHWA's Sustainable Pavements Program (SPP) Overview
- Quantifying Emissions from Pavements
  - Life Cycle Assessment (LCA)
  - Environmental Product Declarations (EPDs)
- Ongoing and Future Initiatives
- Resources

## SPP Vision:

Sustainable thinking is embraced throughout the life-cycle of all publicly owned pavements in the United States.



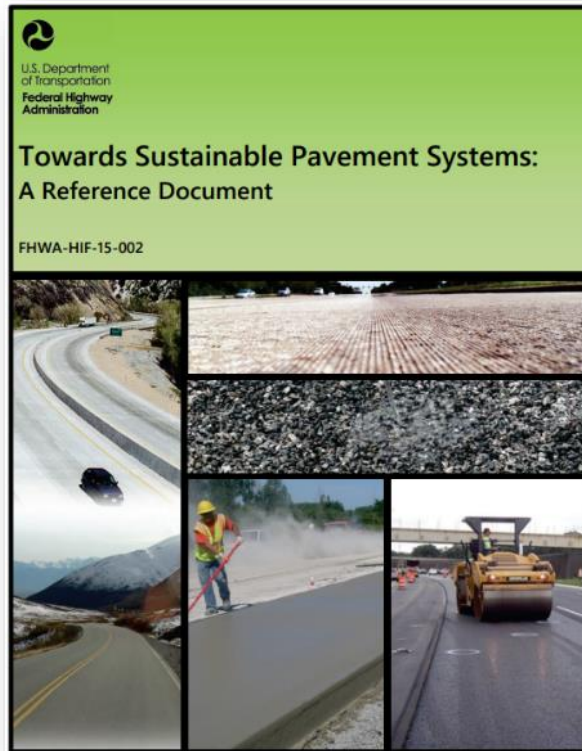
# SPP Mission:

To advance the knowledge and practice of designing, constructing, and maintaining more sustainable pavements through:

- Stakeholder engagement
- Education
- Development of guidance and tools



# Sustainable Pavements Can...



1. Achieve the engineering goals
2. Preserve and (ideally) restore surrounding ecosystems
3. Use financial, human, and environmental resources wisely
4. Meet basic human needs such as health, safety, equity, employment, comfort, and happiness

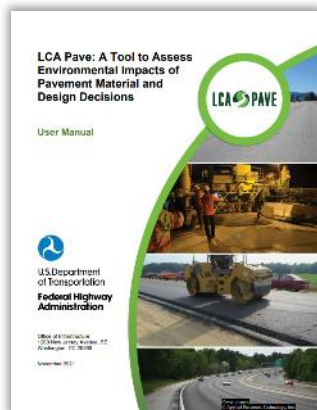
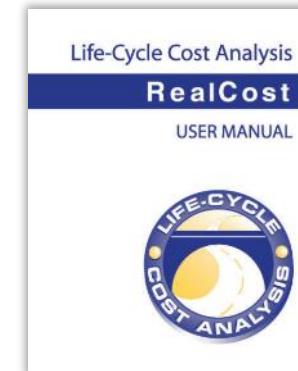
# Balance of the Triple Bottom Line



Sustainability  
Rating Systems  
(e.g., INVEST)  
Social LCA  
(S-LCA)



Life-Cycle Cost Analysis  
(LCCA)



Life-Cycle Assessment  
(LCA)

Icon Image Source:  
FHWA/APTech



# SPP Progress



## Characterizing Pavement Sustainability and Understanding Current Practices

### Life-Cycle Assessment I: Understanding Concepts

- ✓ [Pavement LCA Framework Document](#)
- ✓ [Tech Brief: Pavement Life-Cycle Assessment](#)

## Life-Cycle Assessment II: Application to Pavement Systems, Environmental Product Declarations, and Product Category Rules



- ✓ [Pavement LCA Tool](#)
- ✓ [Tech Brief: Life-Cycle Thinking](#)
- ✓ [Tech Brief: Data Needs for Pavement LCA](#)
- ✓ [Tech Brief: Environmental Product Declarations](#)

## Resiliency of Pavement Systems

- ✓ [Tech Brief: Climate Change Adaptation for Pavements](#)
- ✓ [Peer Exchange on Pavement Resiliency](#)
- ✓ [Pavement Resiliency Summary Report](#)

## PHASE 1: STATE OF KNOWLEDGE

## PHASE 2: IMPLEMENTATION

2011

2012

2013

2014

2015

2016

2017

2018

2019

2020

2021

## Documenting Sustainability Considerations in Pavement Systems

- ✓ [Sustainable Pavements Reference Document](#)
- ✓ [Tech Brief: Pavement Sustainability](#)
- ✓ [Tech Brief: Sustainability Considerations for Asphalt Pavements](#)
- ✓ [Tech Brief: Sustainability Considerations for Concrete Pavements](#)
- ✓ [Webinar Series I: Towards Sustainable Pavement Systems](#)

## Developing a Road Map for the Sustainable Pavements Program

- ✓ [Sustainable Pavements Program Road Map](#)

## Implementing Sustainability Concepts and Practices

- ✓ Case studies, video clips, newsletters, and flyers highlighting sustainable technologies and practices
- ✓ [Webinar Series II: Concepts, Practices, Evaluation and Assessment](#)
- ✓ [Deploying Pavement LCA Tool](#)



# SPP Progress – Current Initiatives



**EO 14057**  
specified goal of  
Net Zero Federal  
Procurement



**25 States  
(+2 Local  
agencies)  
Participating**  
35+ projects from  
27 agencies  
\$7.1M

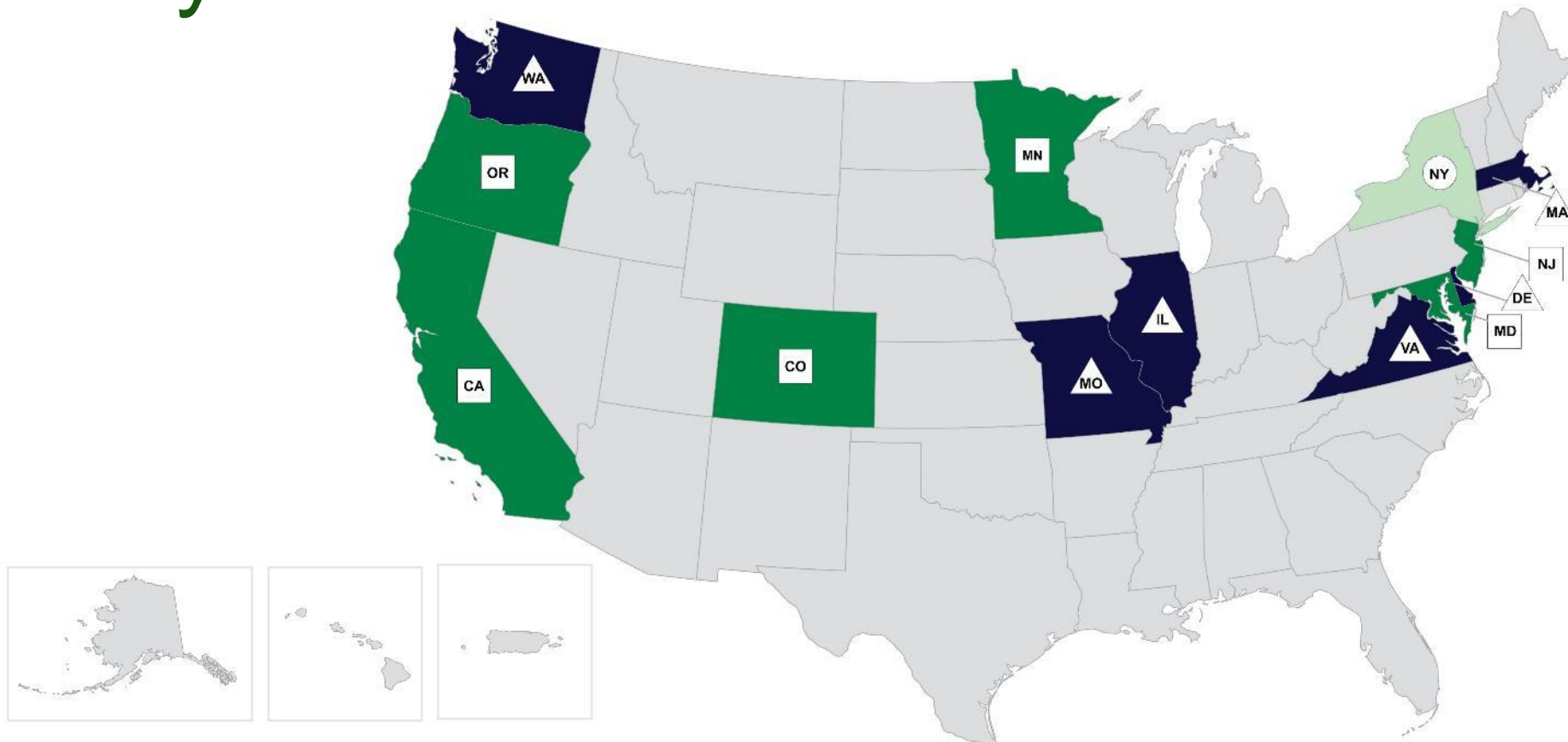


**Inflation  
Reduction Act**  
(Pub. L. No. 117-169)  
**\$2 Billion for FHWA**  
Low-carbon  
transportation  
materials grants



**EDC-7**  
EPDs for  
Sustainable  
Project Delivery

# Buy Clean Policies at the State Level



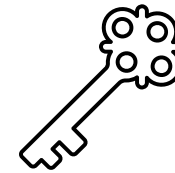
Information collected from  
State legislative websites.

- States with green public purchasing legislation for transportation materials that use EPDs.
- States with green public purchasing legislation, requirements to be determined.
- States that have considered green public purchasing legislation for transportation materials that use EPDs.

# Key Takeaways



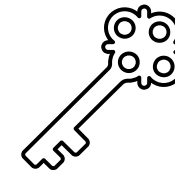
Sustainability is NOT  
only about the  
environmental impacts



If it doesn't meet the  
intended performance,  
it is not sustainable



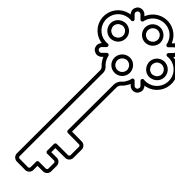
You can't improve what  
you don't measure



LCA  $\neq$  LCCA



Sustainability is  
context sensitive



Sustainability is good  
engineering

# Quantifying Environmental Emissions



# EMISSIONS FROM HIGHWAY TRANSPORTATION SYSTEMS

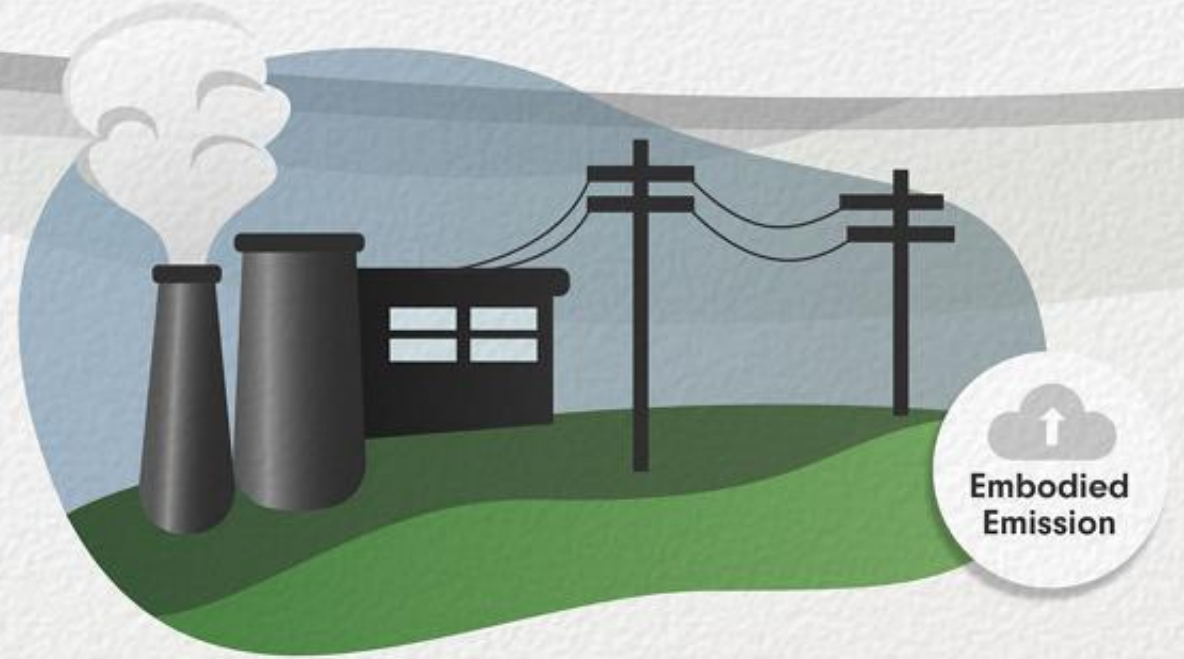
## A Look Beyond the Tailpipe



  
Tailpipe  
Emission

### What are tailpipe emissions?

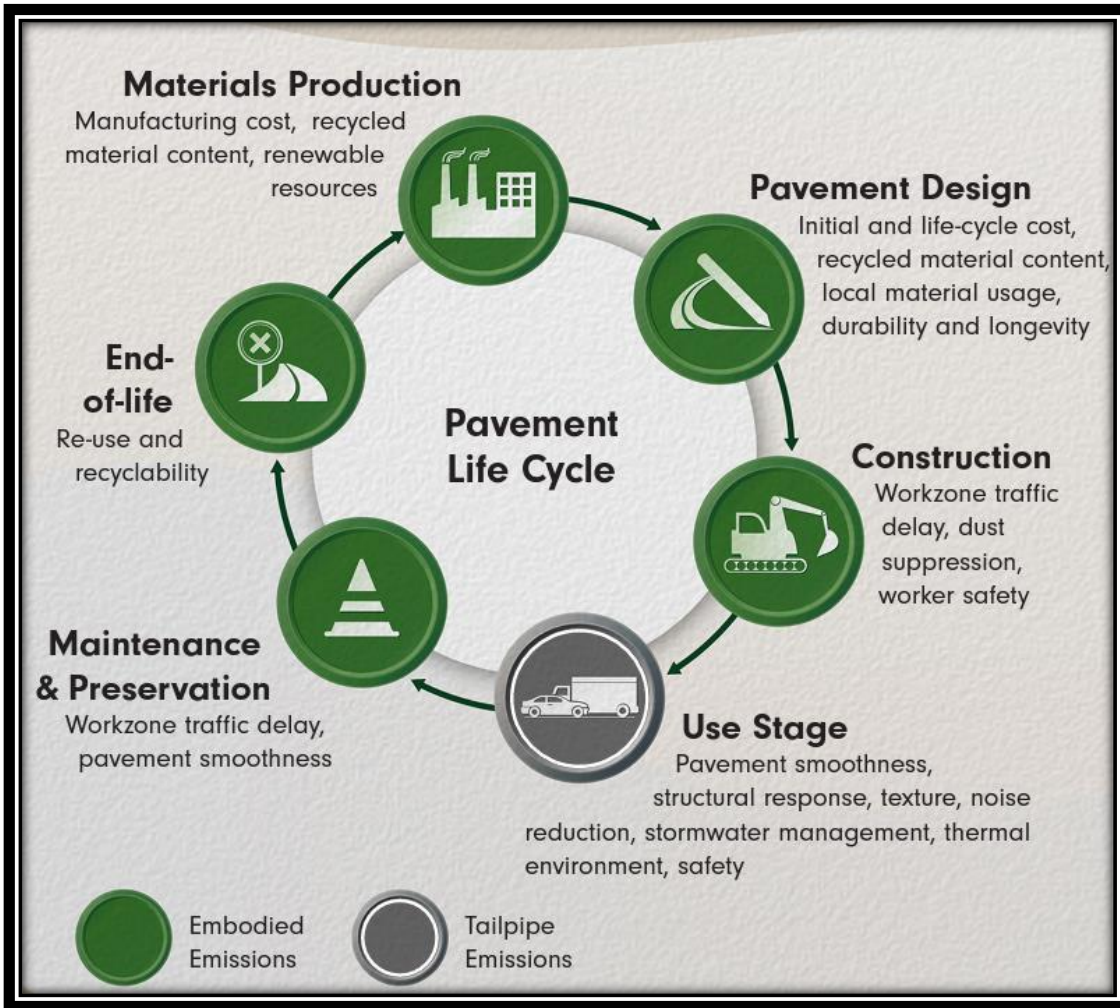
Tailpipe emissions are pollutants from exhaust gases discharged from vehicles equipped with an internal combustion engine. Tailpipe emissions incurred during the use stage of the pavement life cycle are considered operational emissions.



  
Embodied  
Emission

### What are embodied emissions?

Embodied emissions include emissions from manufacturing, material transport, construction, maintenance, and disposal of transportation infrastructure building materials. Embodied emissions of greenhouse gases (GHG) are also known as embodied carbon.



### Operational Carbon

- Released gradually over many years
- Can be changed during service life
- Easier to decarbonize
- Affected by major investments in clean energy and vehicle electrification

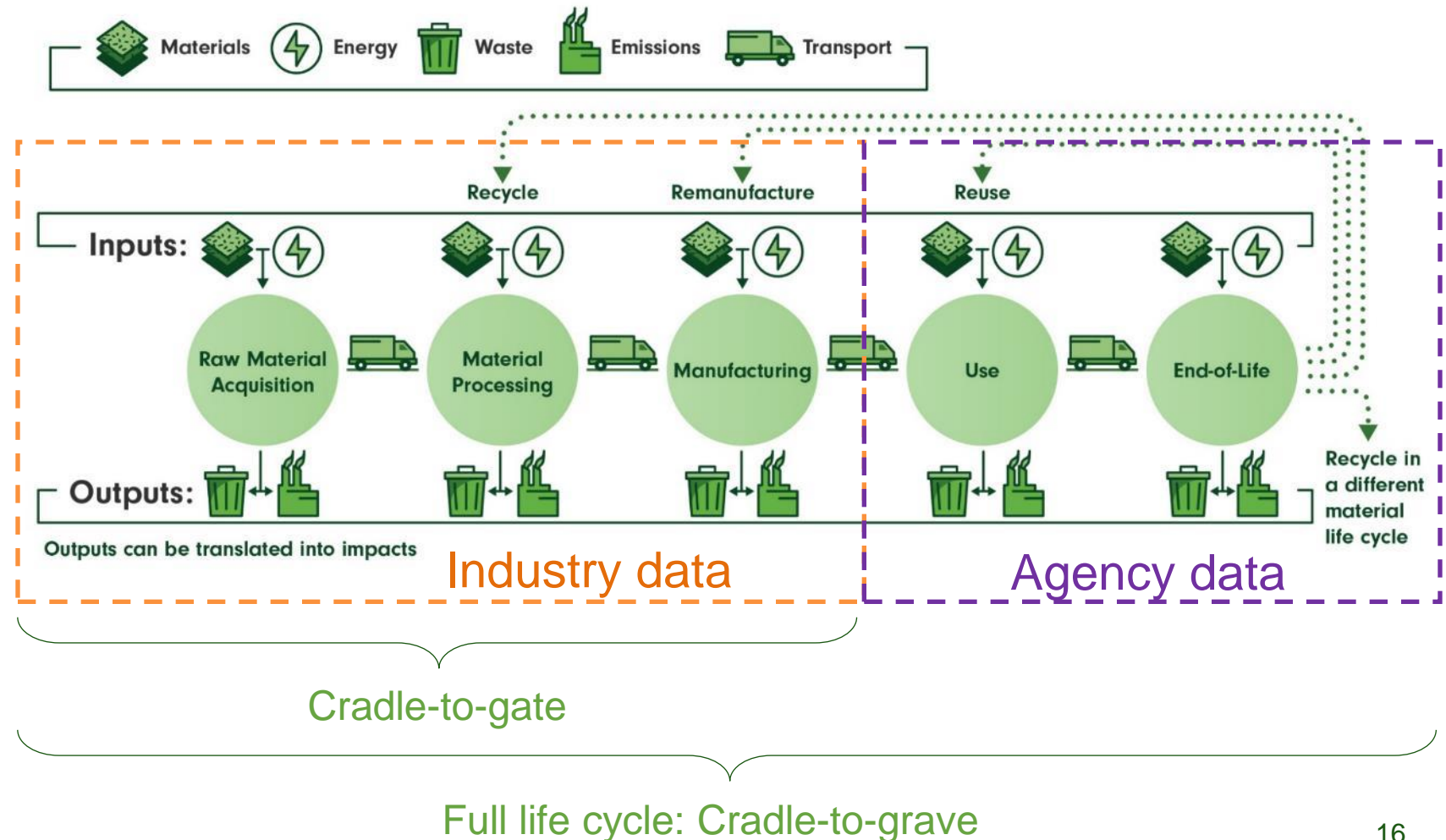
### Embodied Carbon

- Released in a short time period
- Cannot be changed during service life
- Harder to decarbonize
- Limited investments to date

Source: [Emissions from Highway Transportation Systems](#)

# Life Cycle Assessment

- Technique to quantify environmental impacts of products and processes
- Track all inputs and outputs from the system over the life cycle
- Convert outputs into environmental impacts

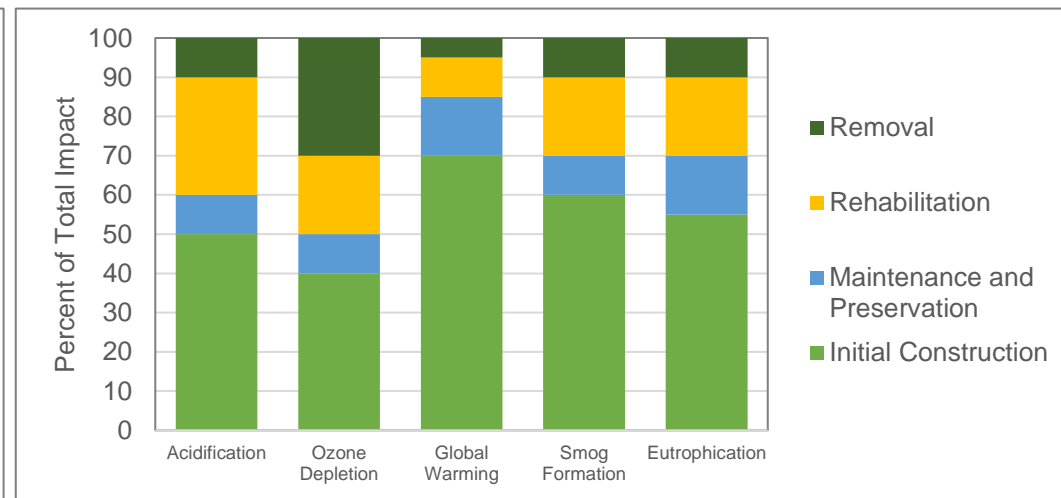
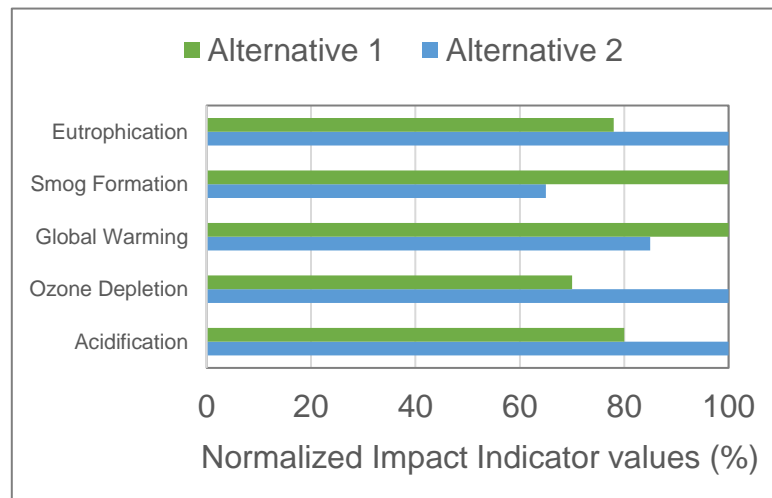




# LCA Benchmarking Tool

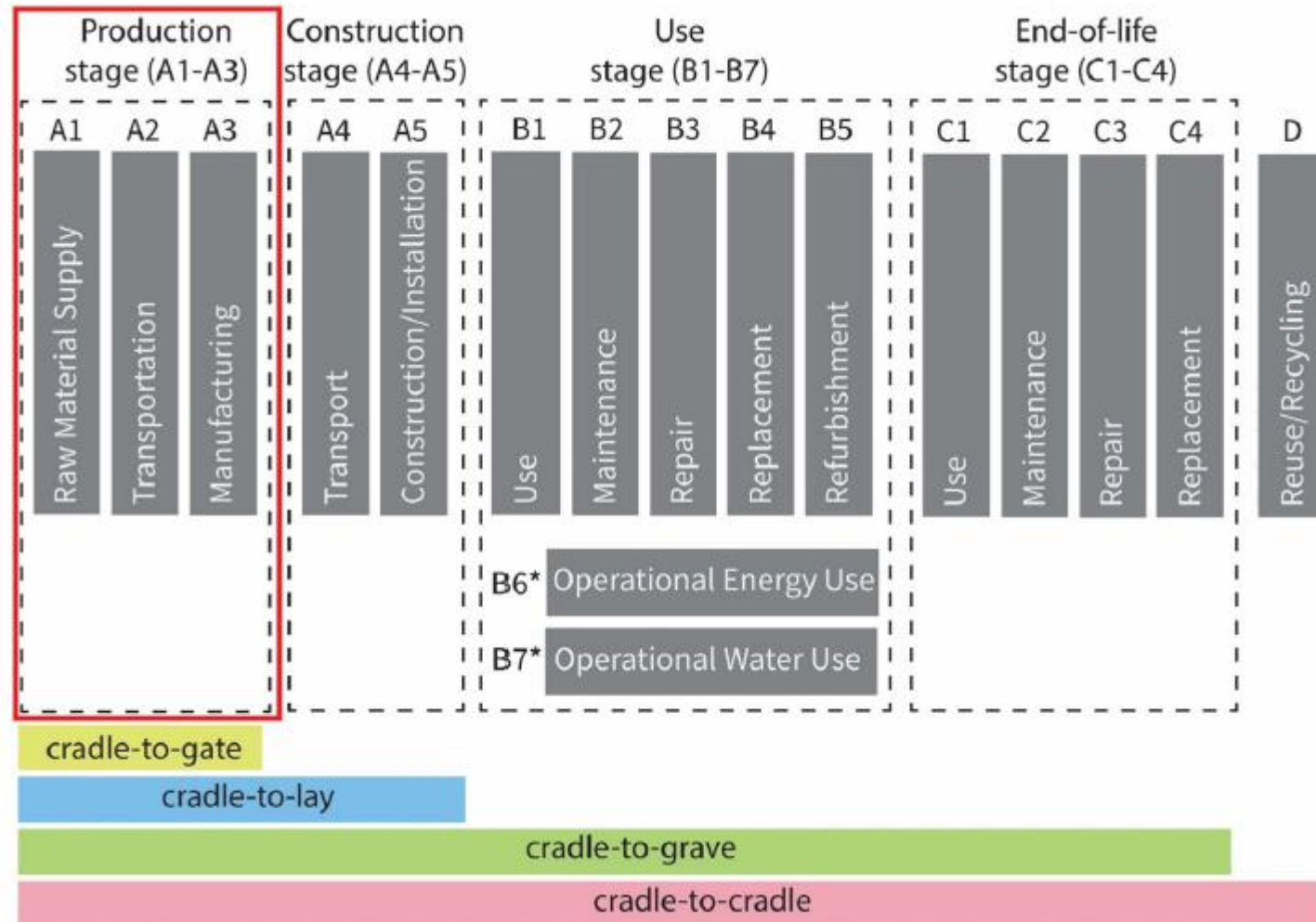


- Created with stakeholder input
- Use the identified background datasets
- Incorporate material EPDs



Available at: <https://www.fhwa.dot.gov/pavement/lcatool/>

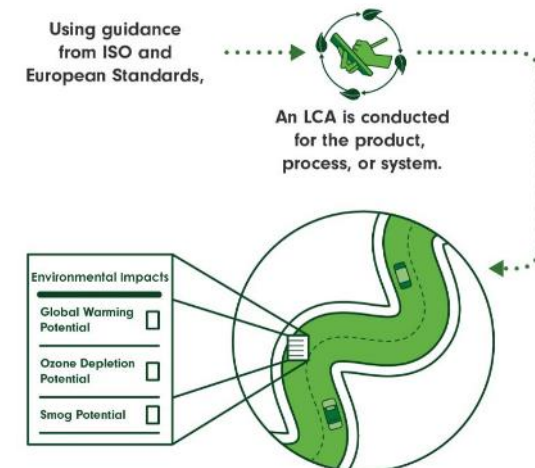
# Life Cycle Stages



Source: University of Colorado-Boulder

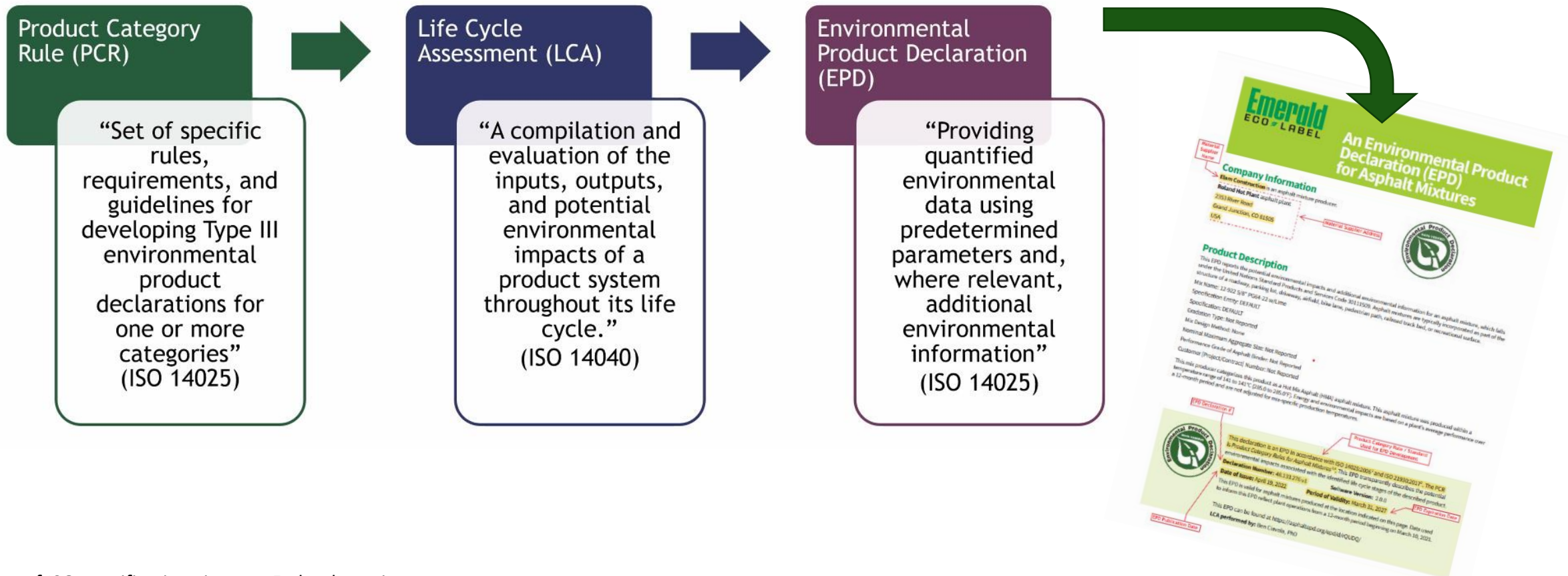
# Considerations When Developing Environmental Product Declarations (EPDs)

- Communicate environmental impacts of material or product
- Express the results of an LCA
- Developed with stakeholder input
- Follow industry standards described in the PCR
- EPDs are not required by Federal law



\*Use of ISO specifications is not a Federal requirement.

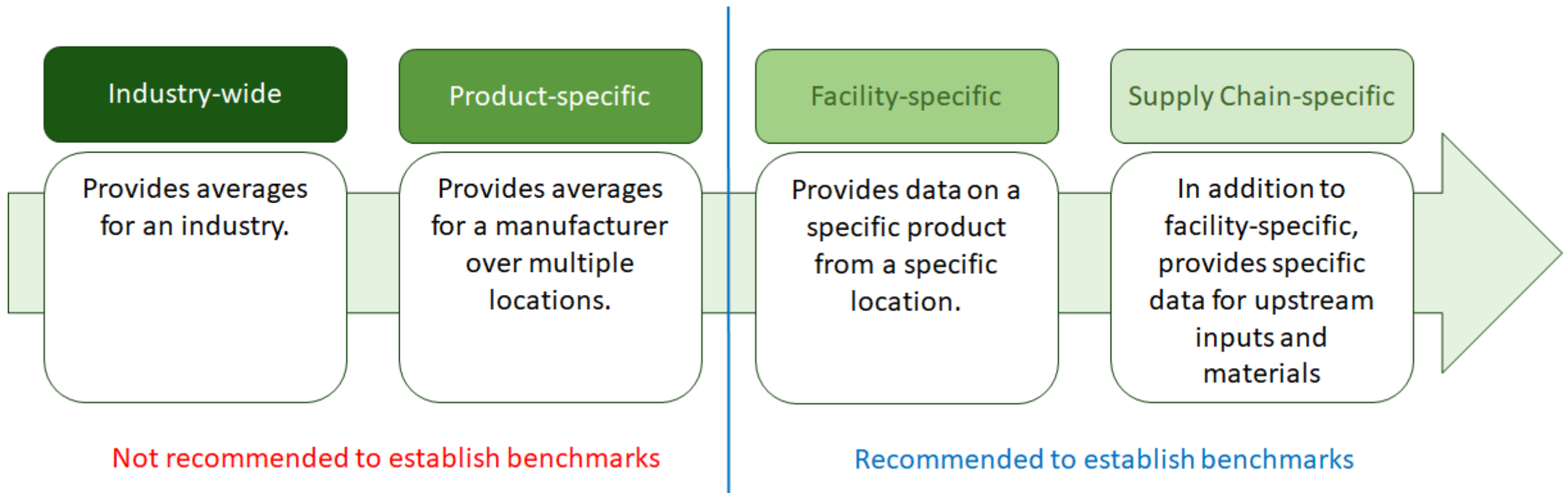
# Process



\*Use of ISO specifications is not a Federal requirement.

# Types of EPDs

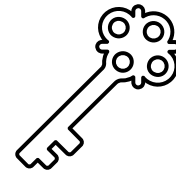
Increasing level of specificity, comparability and usefulness in Buy Clean procurement



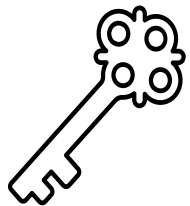
# EPDs Key Messages



EPDs are not required  
by Federal law



A cradle-to-gate LCA  
quantifies environmental  
impacts associated with  
material acquisition,  
processing, and production



LCA and EPDs could be  
leveraged in all areas of the  
project development and  
delivery process

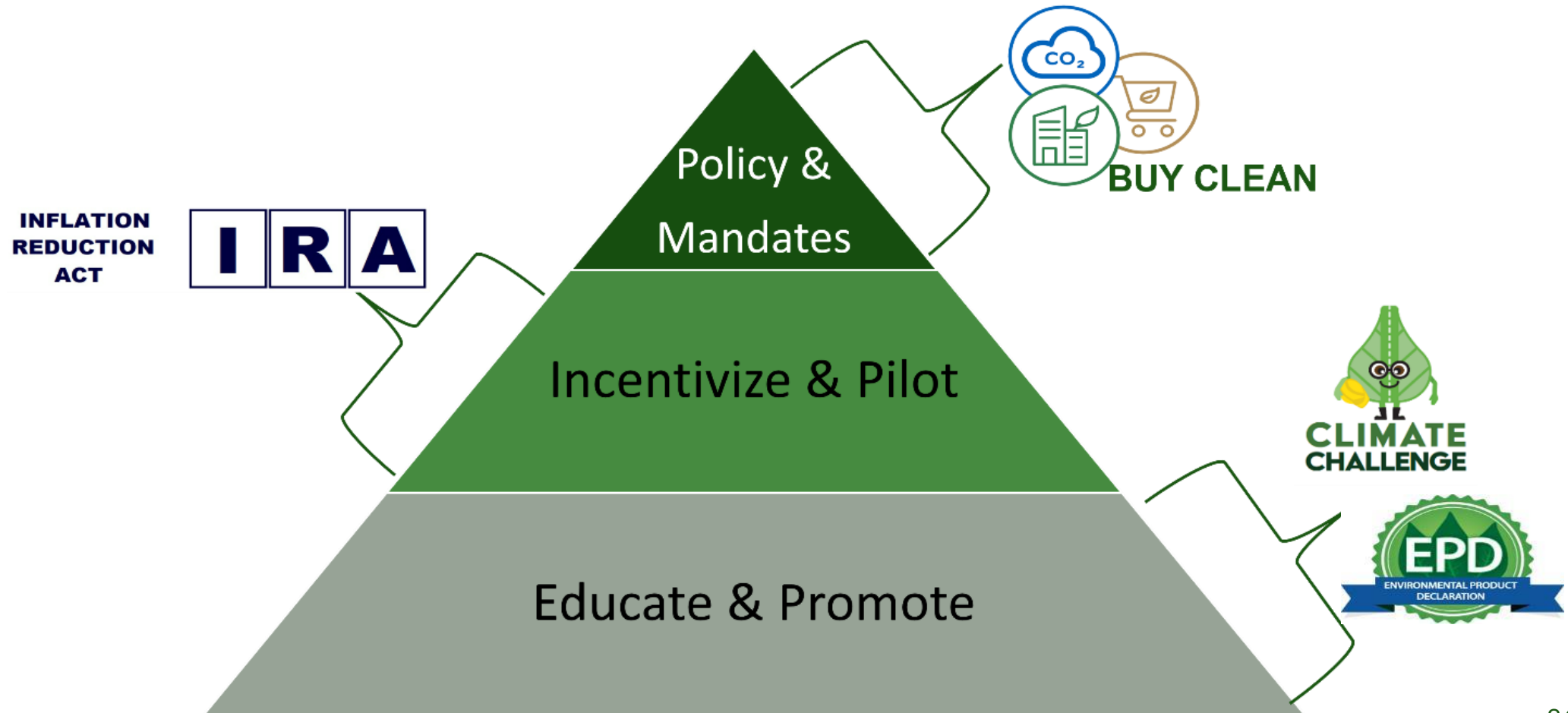


Operational emissions  $\neq$   
embodied emissions

# Ongoing and Future Initiatives



# Example of a possible approach to achieve greenhouse gas (GHG) emissions reduction: building-block approach





# IRA Sections

## Which parts relate to low carbon construction materials?

IRA Section	Agency	Funding	Purpose	Funds obligation deadline
60503	GSA Federal Buildings Fund	\$2.15B	To acquire and install materials/products for use in the construction or alteration of buildings that have substantially lower levels of embodied GHG emissions ( <i>as determined by EPA</i> )	9/30/26
60506	DOT FHWA	\$2B	To reimburse or provide incentives (up to 2% of incremental costs) to eligible recipients for the use of construction materials/products that have substantially lower levels of embodied GHG emissions ( <i>as determined by EPA</i> )	9/30/26
60116	EPA	\$100M	For administrative costs to develop ( <i>with GSA and DOT-FHWA</i> ) a program to identify and label construction materials/products that have substantially lower levels of embodied GHG emissions, based on EPDs and determinations by State agencies, as verified by EPA.	9/30/26
60112	EPA	\$250M	Grants and technical assistance to businesses, states, tribes and nonprofit organizations to support the development, enhanced standardization and transparency, and reporting criteria for EPDs for construction materials/products that include measurements of the embodied GHG emissions across all life cycle stages	9/30/31
50161	DOE	\$5.812B	For financial assistance for advanced technology retrofits for US industrial or manufacturing facilities that produce iron, steel, steel mill products, aluminum, cement, concrete, glass, and other energy intensive industrial processes	
	DOE	\$10B	For the 48C tax credit to expand clean technology manufacturing	
30002	HUD	\$837.5M	For direct loans and grants to improve climate resilience of affordable housing, including low- emission building materials/processes	
70006	FEMA		May provide financial assistance for costs associated with low-carbon materials	

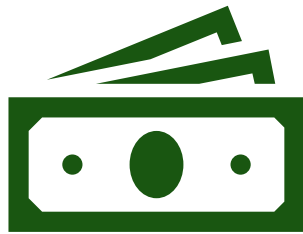
**INFLATION  
REDUCTION  
ACT**



# Inflation Reduction Act Section 60506 Low Carbon Transportation Materials Overview

[IRA \(Pub. L. No. 117-169, Aug. 16, 2022\)](#)  
[FHWA's IRA Program Website](#)

# Low Carbon Transportation Materials (IRA § 60506)



**\$2 Billion**



**September  
2026**



**Reimburse**  
(Incremental costs  
of using)  
**or**  
**Provide**  
**Incentives**  
(2% of cost)

# Low Carbon Transportation Materials (IRA § 60506)

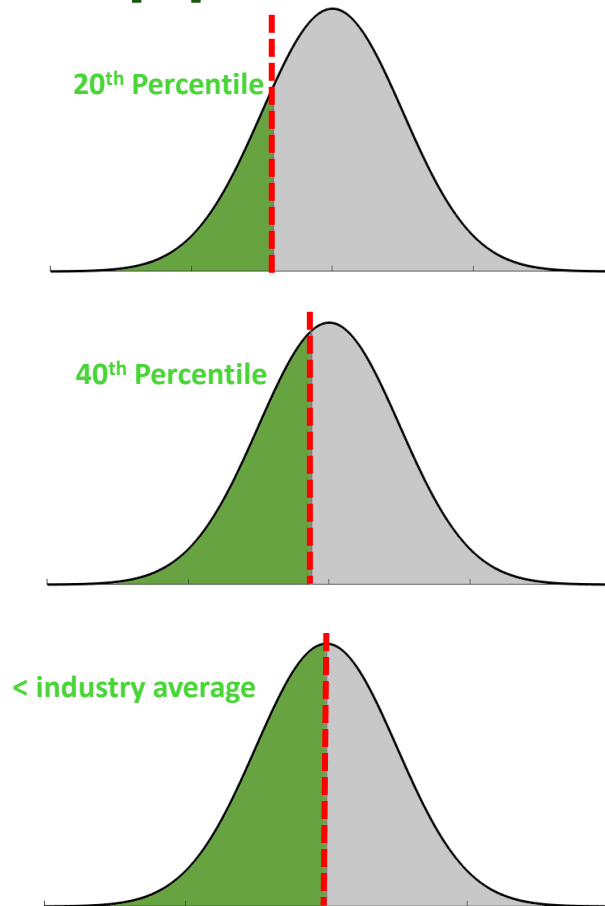
- Eligible Recipients:

- a State;
- a unit of local government;
- a political subdivision of a State;
- a territory of the United States;
- an entity described in section 207(m)(1)(E) (Federally recognized Indian Tribe);
- a recipient of funds under section 203 (Federal Land Management Agencies);
- a metropolitan planning organization (as defined in section 134(b)(2)); or
- a special purpose district or public authority with a transportation function [§ 60506; 23 U.S.C. 179(c)(2)].

# What are “Substantially Lower” Materials?

- Defined by [EPA Interim Determination](#) dated 12/12/2022
- Highest Global Warming Potential (GWP) impact in the product stage (A1-A3):
  - Concrete
  - Glass
  - Asphalt mix
  - Steel
- Qualify materials based on:
  - Environmental Product Declarations (EPDs), and
  - Quantile approach thresholds (i.e. 20<sup>th</sup>/40<sup>th</sup> percentiles and better than industry average)

# EPA Interim Determination Quantile Approach Thresholds



What qualifies as “substantially lower”?

↓

Lowest 20 percent in embodied greenhouse-gas emissions

↓

Alternate Qualification:  
Lowest 40 percent in embodied greenhouse-gas emissions

↓

Final Alternate Qualification:  
Better than the estimated industry average

# Climate Challenge: Quantifying the Emissions of Sustainable Pavements

State DOTs explore the use of EPDs and LCAs as a standard practice to inform pavement material and design selection for enhancing sustainable pavement practices and quantify the emissions and impacts of those practices.

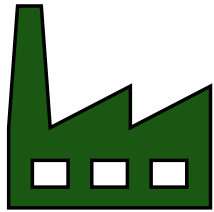


For the latest information, visit the website: <https://highways.dot.gov/climatechallenge>

# Opportunities Across the Pavement Life Cycle

## Design and Construction

### Production



#### Raw Material EPDs (binder, aggregates, etc.)

- Recycled Content
- Biobinders
- Increased energy efficiency
- Fuel selection

### Construction



#### Asphalt EPDs LCAs

- Perpetual Pavement Design/long-life design
- Innovative construction practices
- Construction fleets

### Operations



#### LCAs EPDs for P&R

- A large portion of tailpipe emissions are included
- Maintain smoothness
- Ensure longevity
- Minimize disruption
- P&R: Material Selection

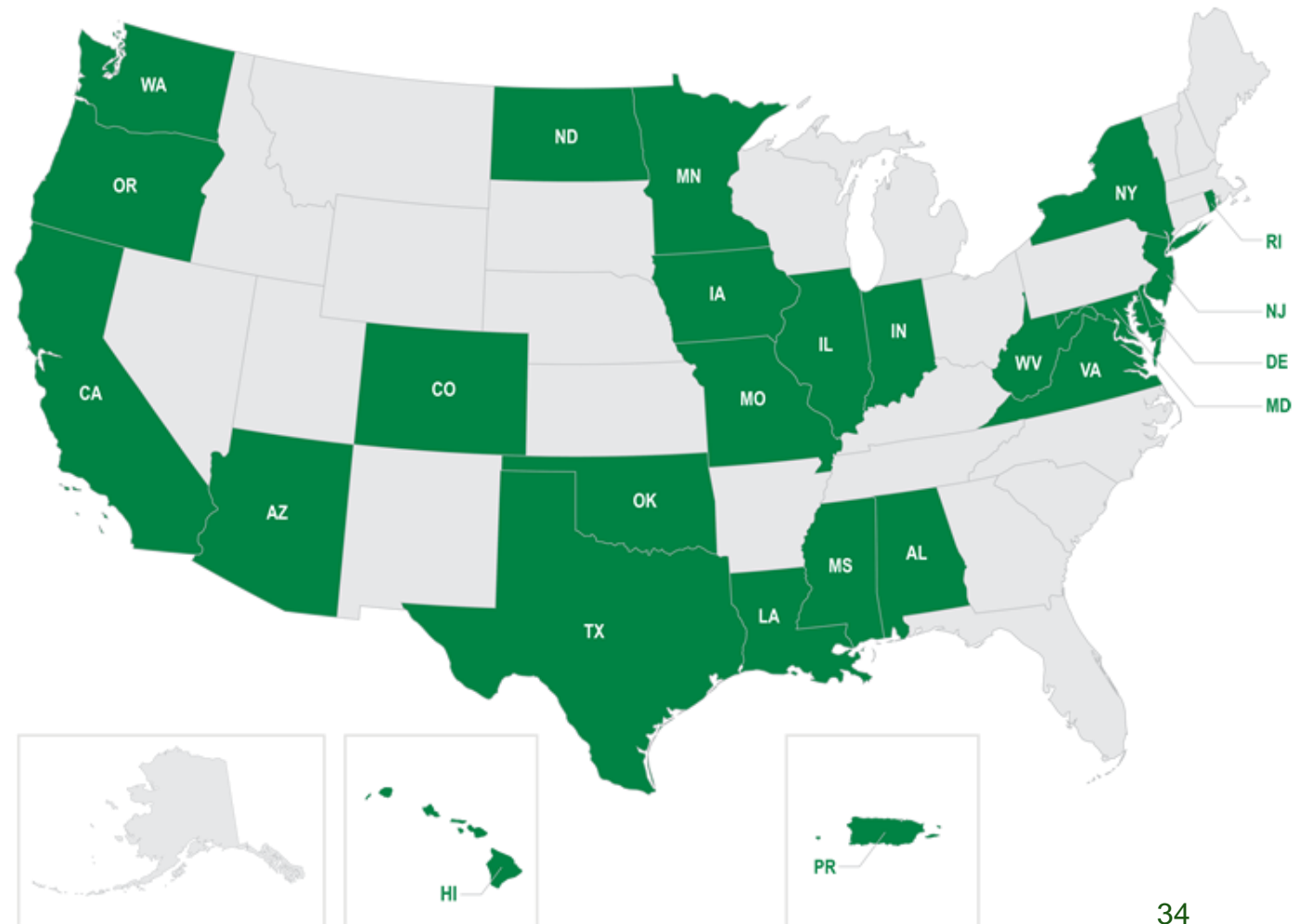


# Climate Challenge Program Timeline



# Climate Challenge Participants

- 30+ proposals from 27 State agencies (including 2 local agencies)
  - Education, implementation, benchmarking, fundamental research
- Providing technical and funding (\$7.1 million) assistance



# Synergy: Suggestions for Materials and Specifications



OKLAHOMA  
Transportation



- Quantifying GHG emissions of different mixture designs
- Focus on performance-engineered mixtures (PEM), balanced mix design (BMD) recycled materials, warm-mix asphalt (WMA) & bio-based materials
- Collect asphalt & concrete construction data in OpenLCA format

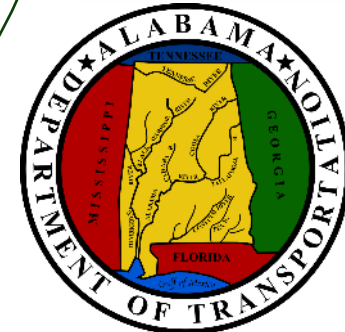


**COLORADO**

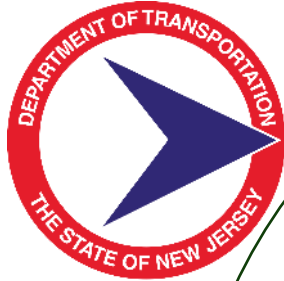
Department of Transportation



LOUISIANA DEPARTMENT OF  
TRANSPORTATION & DEVELOPMENT



# Synergy: Suggestions for Pavement Performance and Materials



- Use of EPDs in the context of “whole pavement LCA”
- Pavement deterioration modeling and pavement LCA
- Use phase implications
- Long-life pavements



# Synergy: DOT Processes, Industry Capacity



- Collecting EPDs and integration of life cycle thinking in State DOT business processes
- Supporting industry to develop capacity
- Establishing strategic action plans based on readiness assessment



# Buy Clean Policies and EPDs Community of Knowledge Quarterly Meeting – Status:

- Kick-off held on August 10, 2022
  - Sustainable Principles and Common Misconceptions
- November 8, 2022
  - PCR Getting Started with Buy Clean Policies
- February 7, 2023
  - Relevance of Background Data and Data Quality Assessment for EPD
- June 6, 2023
  - Deriving Benchmarks for Construction Materials Based on EPDs

Technical Presentation Recordings  
<https://www.fhwa.dot.gov/pavement/sustainability/epds/resources/>

**Buy Clean Policies and Environmental Product Declarations (EPDs)  
Community of Knowledge Quarterly Webinar**

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**ESTABLISHING BENCHMARKS USING INDUSTRY AVERAGES**

**MONDAY, SEPTEMBER 11, 2023**

Public sector agency employees and their consultants are encouraged to join us for this virtual webinar.

This event will discuss how transportation agencies can use industry provided greenhouse gas emissions data to identify materials that meet specific global warming potential thresholds, such as those established by the Environmental Protection Agency (EPA) Interim Determination for Low Carbon Materials at the 20th and 40th percentiles, and industry average.

- Learn about benchmark considerations to establish thresholds.
- Understand the process and methodologies available to establish benchmarks based on materials' EPDs and other critical information.
- Discuss reliance on industry collaboration.



QUESTIONS	AGENDA
<ul style="list-style-type: none"> <li>• What is the role of the agency?</li> <li>• How can an agency establish thresholds to qualify materials at specific percentiles?</li> <li>• What information (e.g., type of EPDs, design mix, etc.) does an agency need to request from industry?</li> </ul>	<p><b>2:00 - 2:05 p.m.</b> Welcome / Introduction <i>Migdalia Carrion</i></p> <p><b>2:05 - 2:35 p.m.</b> Presentations <i>Jaep Meijer, The Right Environment</i> <i>Dr. Amlan Mukherjee, WAP Sustainability</i></p> <p><b>2:35 - 2:55 p.m.</b> Open Discussion</p> <p><b>2:55 - 3:00 p.m.</b> Closing Remarks <i>Migdalia Carrion</i></p>

**Register for the Webinar**

For more information, please visit the [Sustainable Pavements Program website](https://www.fhwa.dot.gov/pavement/sustainability/).

Sign up to become a member of the Community of Knowledge Quarterly Webinar.



# EDC-7 Innovation: EPDs for Sustainable Project Delivery



U.S. Department of Transportation  
**Federal Highway Administration**





**EPD**  
ENVIRONMENTAL  
PRODUCT  
DECLARATION

*Environmental Impacts*

- Global Warming Potential
- Ozone Depletion Potential
- Smog Potential
- Acidification Potential

*Environmental Impacts*

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Global Warming Potential

Source: FHWA

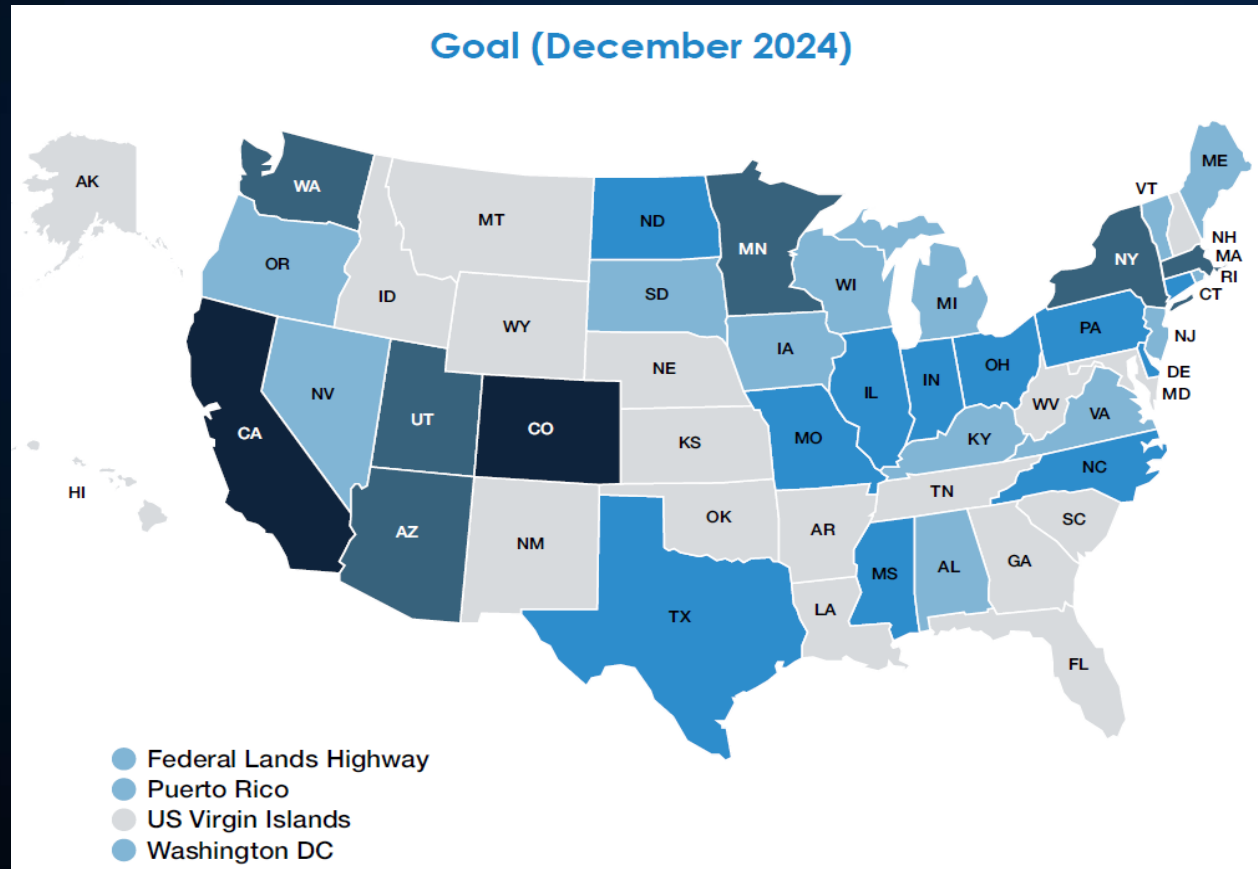
# EDC-7 EPDs for Sustainable Project Delivery Innovation

## Collection of EPDs

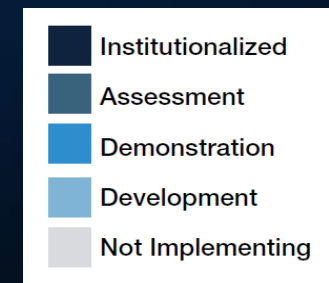
- Contract and specifications language
- Selection of appropriate materials and bid items
- Database, tools, and best practices
- Educates on uses throughout the project delivery process



# EPDs for Sustainable Project Delivery Participants



Agencies Participating	Amount
Total Possible Agencies:	54
Agencies Implementing:	35 (65%)
Climate Challenge Participants:	20
Total Agencies:	43



# EPDs for Sustainable Project Delivery Resources

- EDC - 7 EPDs Innovation website: [https://www.fhwa.dot.gov/innovation/everydaycounts/edc\\_7/sustainable\\_epds.cfm](https://www.fhwa.dot.gov/innovation/everydaycounts/edc_7/sustainable_epds.cfm)
- FHWA SPP dedicated website to
- EPDs : <https://www.fhwa.dot.gov/pavement/sustainability/epds/>

The screenshot shows the FHWA Center for Accelerating Innovation website. The main content area features a green-themed graphic with a winding road and a car. A central box displays an 'EPD ENVIRONMENTAL PRODUCT DECLARATION' badge. To the right, a section titled 'Environmental Impacts' shows a checkmark next to 'Global Warming Potential'. Below the graphic, the text reads: 'An Environmental Product Declaration (EPD) is a tool that can demystify the environmental impacts of construction materials. As State departments of transportation (DOTs) become increasingly conscious of infrastructure's environmental burdens and seek more sustainable strategies, they are looking for measures that accurately reflect the environmental impacts of each alternative. EPDs communicate the greenhouse gas (GHG) emissions of construction materials in a transparent and standardized manner. They provide an opportunity to reduce negative environmental impacts by transforming the project delivery process. A Simple Yet Robust Environmental Reporting Tool. The manufacture, transportation, and production of construction materials such as aggregate, asphalt, cement, asphalt mixtures, concrete mixtures, and steel reinforcement generates environmental impacts. An EPD is a transparent, third party verified report used to communicate those impacts from resource use, energy, and emissions. Type III EPDs are product labels developed in accordance with the International Organization for Standardization (ISO) Standard 14025 (ISO 2006). These EPDs are developed using life-cycle assessment (LCA) methodology, follow the industry consensus, and undergo third-party verification before being published. Agencies can leverage the use of EPDs to support decision-making throughout the project delivery process. Agencies can request EPDs at material installation to establish and develop benchmarks for current designs, and projects. This tool will help agencies reduce GHG emissions in their construction projects.'

On the right side of the page, there is a 'Contacts' section with the following information:  
**LaToya Johnson**  
FHWA Office of Infrastructure  
(202) 366-0479  
[LaToya.Johnson@dot.gov](mailto:LaToya.Johnson@dot.gov)  
**Migdalia Carrion**  
FHWA Office of Infrastructure  
(202) 368-9033  
[Migdalia.Carrion@dot.gov](mailto:Migdalia.Carrion@dot.gov)

Below the contacts is a 'Resources' section with links for:  
Fact sheet  
Subscribe to Sustainable Pavement Program e-News  
FHWA Sustainable Pavements Program  
FHWA EPD Tech Brief

The screenshot shows the FHWA Pavements website. The main content area features a green-themed graphic with a winding road and a car. A central box displays an 'EPD ENVIRONMENTAL PRODUCT DECLARATION' badge. To the right, a section titled 'Environmental Impacts' shows a checkmark next to 'Global Warming Potential'. Below the graphic, the text reads: 'Environmental Product Declarations (EPDs) for Sustainable Project Delivery. Highway pavement construction involves such as concrete and asphalt from environmental impacts during their life cycle. To improve the product declaration, or EPD, obtained from projects, this reporting tool helps stakeholders support procurement decisions and quantify embodied carbon reductions using life cycle assessments (LCA) for sustainable pavements.'

At the bottom of the page, there are three icons: a green circular badge with 'EPD ENVIRONMENTAL PRODUCT DECLARATION', a green tag with 'EPDs', and a laptop displaying a graph.

# NHI-131134 Integrating Sustainability into Infrastructure Decision-Making

- Optional course that provides general education on sustainability concepts and addresses how sustainability metrics can be incorporated throughout the project delivery process for transportation infrastructure assets, including pavement projects.
- Leverages:
  - Gamification
  - Micro-learning
  - Self-directed
  - Experiential learning



# Resources

- <http://www.fhwa.dot.gov/pavement/sustainability>



## Education

[Pavement LCA Framework](#)

[Webinars](#)

[Tech briefs, studies](#)

[Technical articles](#)



## Research

[LCA fit in transportation decision-making](#)

[EPDs in Green Public Procurement](#)

[LCA of recycled plastics in pavements](#)

[LCA of ground tire rubber in pavements](#)



## Deployment

[LCAPave Tools](#)

[Pilot projects with State DOTs](#)

[Climate Challenge](#)

[EDC 7- EPD for Sustainable Project Delivery](#)

# Migdalia Carrion

(Migdalia.Carrion@dot.gov)



<http://www.fhwa.dot.gov/pavement/sustainability>