



# FHWA's Climate Challenge and Other Sustainable Pavement Program Initiatives



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FHWA Resource Center

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# 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

- DOT Department of Transportation
- EPD Environmental Product Declaration
- FHWA Federal Highway Administration
- GHG Greenhouse Gas Emissions
- GPP Green Public Procurement
- IRA Inflation Reduction Act
- LCA Life Cycle Assessment
- LCCA Life Cycle Cost Analysis
- PCR Product Category Rule
- SPP Sustainable Pavements Program

# Agenda

- What is a sustainable pavement?
- EPDs 101
- Current FHWA Initiatives
  - Climate Challenge
  - EDC-7 – EPDs for Sustainable Project Delivery
  - IRA Low Carbon Transportation Materials
- Resources



# What Is a Sustainable Pavement?

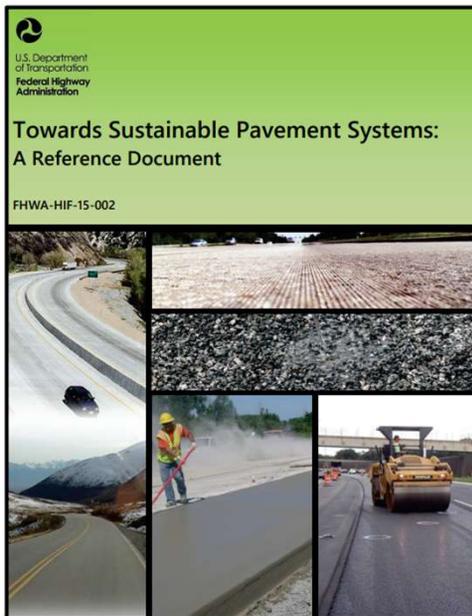


# FHWA's Vision for Pavements & Materials

*Ensure that pavements are designed, constructed, preserved, and maintained to accommodate current and predicted traffic needs and consider **economic, environmental, and social impacts** throughout the pavement's life cycle.*



# 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



Icon Image Source:  
FHWA/APTech

# Quantifying Impacts



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

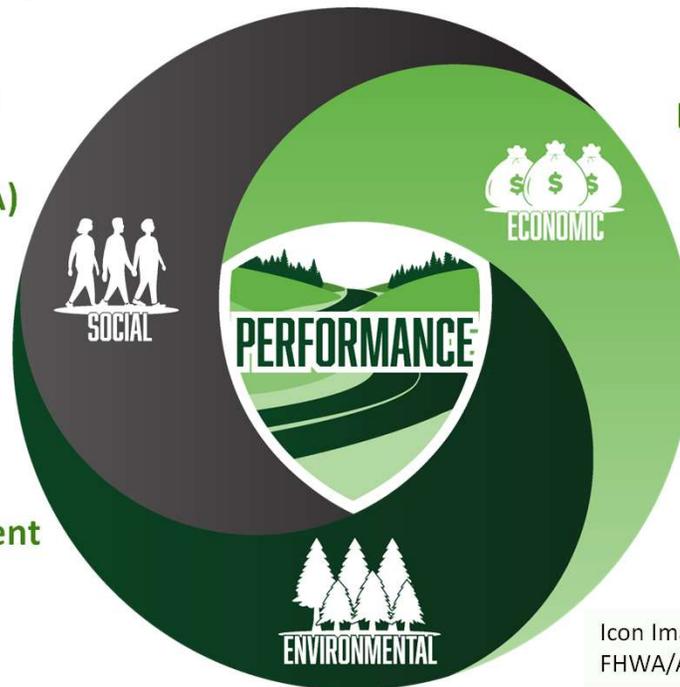
Life-Cycle Cost Analysis (LCCA)



Life-Cycle Assessment (LCA)



Environmental Product Declarations (EPD)



Life-Cycle Cost Analysis  
**RealCost**  
USER MANUAL



Icon Image Source:  
FHWA/APTech

# 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



Sustainability is  
context sensitive



Sustainability is good  
engineering



LCA  $\neq$  LCCA



U.S. Department of Transportation  
Federal Highway Administration

# Environmental Product Declarations (EPDs) 101



# EMISSIONS FROM HIGHWAY TRANSPORTATION SYSTEMS

## A Look Beyond the Tailpipe



### 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.



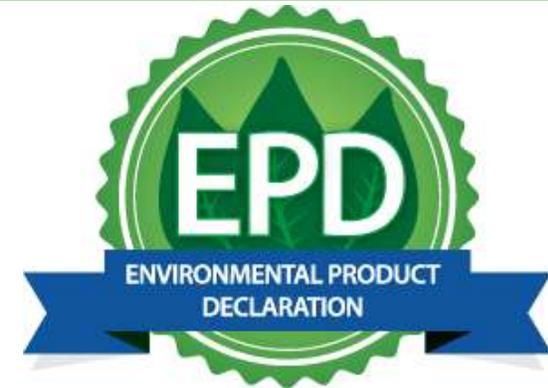
### What are embodied emissions?

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.

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

# What are EPDs?

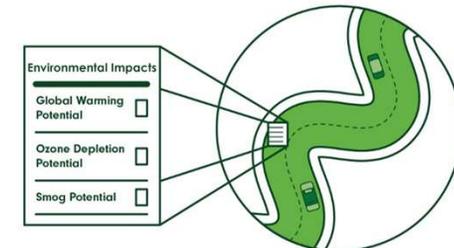
- Communicate environmental impacts of material or product
- Express the results of an LCA
- Developed with stakeholder input
- Follow industry standards described in the PCR
- EPDs are not currently required by Federal law or regulation



Using guidance from ISO and European Standards,



An LCA is conducted for the product, process, or system.



Note: The use of ISO specifications or European Standards is not a Federal requirement.

# How are EPDs Produced?

## Step 1 – Develop a PCR



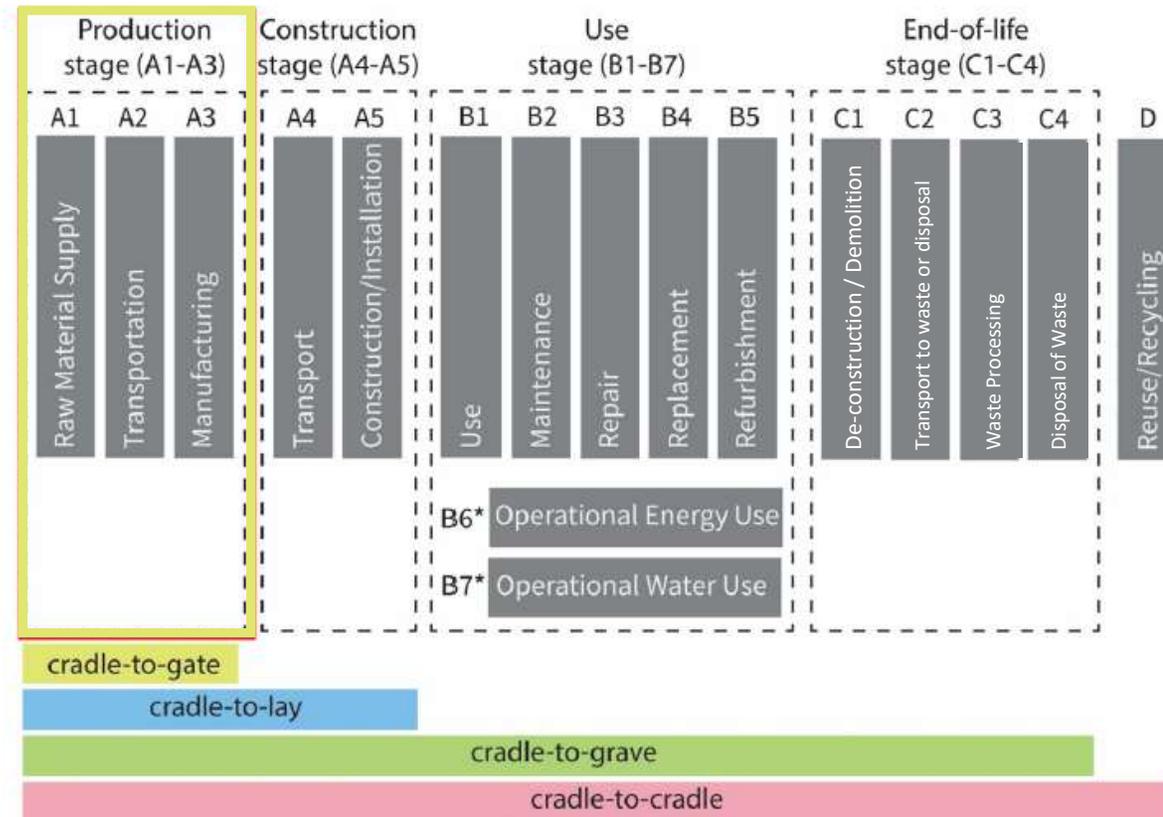
- PCRs are sets of **industry–consensus standards** and guidelines used to develop EPDs for a specific category
- PCRs ensure EPD:
  - Consistency
  - Transparency

Material	Program Operators
Portland Cement	<a href="#">PCA / ASTM International</a>
Slag Cement	<a href="#">ASTM International/ Slag Cement Association</a>
Steel	<a href="#">UL environment</a>
Hot Mix Asphalt	<a href="#">National Asphalt Pavement Association</a>
Concrete	<a href="#">NRMCA/ NSF International</a>
Aggregates	<a href="#">ASTM International</a>

# How are EPDs Produced?

## Step 2 – Conduct LCA

- To inform and support PCR
- Helps determine the assumptions and data specified in PCR



Source: University of Colorado-Boulder



# How are EPDs Produced? Step 3 – Create EPD

## Asphalt Mixtures

## Concrete Materials

## Steel Materials

**Company Information**  
Solterra Materials LLC is an asphalt mixture producer.  
Buckeye Plant asphalt plant  
16402 S Tutuill Rd  
Buckeye, AZ 85326  
USA

**Product Description**  
This EPD reports the potential environmental impacts and additional environmental information for an asphalt mixture, which falls under the United Nations Standard Products and Services Code 30111509. Asphalt mixtures are typically incorporated as part of the structure of a roadway, parking lot, driveway, airfield, bike lane, pedestrian path, railroad track bed, or recreational surface.  
Mix Name: S21-2.1W  
Specification Entity: NAC  
Specification: C-3/4" High Volume Gyratory Mix  
Gradation Type: dense  
Mix Design Method: superpave  
Nominal Maximum Aggregate Size: 0.75 inches  
Performance Grade of Asphalt Binder: PG 70-10  
Customer (Project/Contract) Number: Not Reported

This mix producer categorizes this product as a Hot Mix Asphalt (HMA) asphalt mixture. This asphalt mixture was produced within a temperature range of 162 to 189°C (324 to 352°F). Energy and environmental impacts are based on a plant's average performance over a 12-month period and are not adjusted for mix-specific production temperatures.

This declaration is an EPD in accordance with ISO 14025:2006<sup>1</sup> and ISO 21930:2017<sup>2</sup>. The PCR is Product Category Rules for Asphalt Mixtures<sup>3</sup>. This EPD transparently describes the potential environmental impacts associated with the identified life cycle stages of the described product.  
Declaration Number: 44.136.307 v1. Software Version: 2.0.0  
Date of Issue: April 20, 2022. Period of Validity: March 31, 2023  
This EPD is valid for asphalt mixtures produced at the location indicated on this page. Data used to inform this EPD reflect plant operations from a 12-month period beginning on Jan. 1, 2021.  
This EPD can be found at <https://epdhallof.org/epd/44.136.307>  
LCA performed by: Ben Corvill, PhD.

Source: NAPA

**ENVIRONMENTAL IMPACTS**

Global Warming Potential (kg CO <sub>2</sub> e)	275
Ozone Depletion Potential (kg CFC-114e)	6.46E-6
Acidification Potential (kg SO <sub>2</sub> e)	0.86
Eutrophication Potential (kg N-e)	0.32
Photochemical Oxidant Creation Potential (kg O <sub>3</sub> e)	19.0
Asiatic Aquatic Toxicity (kg 10-e)	5.27E-5
Asiatic Terrestrial Toxicity (kg 10-e)	807
Total Waste Disposed (kg)	79.6
Consumption of Freshwater (m <sup>3</sup> )	3.39

**Declared Product:**  
Mix 1555725 - Apache Junction Plant  
Description: Elite Sports 3000, 55.25% Ash  
Compressive strength: 3000 PSI at 28 days

**Declared Unit:** 1 m<sup>3</sup> of concrete

**Product Components:** inert aggregate (ASTM C33), natural aggregate (ASTM C33), Portland cement (ASTM C150), fly ash (ASTM C915), batch water (ASTM C1082) admixtures (ASTM C494)

**Additional detail and impacts are reported on page three of this EPD**

**ISO 21930:2017 Sustainability in Building Construction — Environmental Declaration of Building Products: series as the core PCR for Concrete, NSF International, August 2021 v2.1 series as the sub-category PCR**

Sub-category PCR review was conducted by Thomas P. Gloria - Industrial Ecology Consultants

Independent verification of the declaration, according to ISO 14025:2006:  internal  external

Third party verifier Thomas P. Gloria ([tpg@industrial-ecology.com](mailto:tpg@industrial-ecology.com)) - Industrial Ecology Consultants

For additional explanatory material  
Manufacture Representative: David Fox ([dfox@cemex.com](mailto:dfox@cemex.com))  
Software Tool: CarbonCLARITY Suite, EPD Generator • Verification  
LCA & EPD Developer: Climate Earth ([epdreport@climateearth.com](mailto:epdreport@climateearth.com))

Source: ASTM/Cemex

**ENVIRONMENTAL PRODUCT DECLARATION**  
Steel Reinforcing Bar and Merchant Bar  
Designated Steel Construction Product

**EPD PROGRAM AND PROGRAM OPERATOR**  
Name, Address, Logo, and Website: 333 PROCTOR ROAD, NORTHWOOD, IL 60611  
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER: General Program Instructions v2.7.2022  
MANUFACTURER NAME AND ADDRESS: Nucor Steel Seattle, Inc. 2424 SW Anander Street, Seattle, WA 98106  
DECLARATION NUMBER: 4796291507.101.1  
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT: Steel Reinforcing Bar and Merchant Bar, 1 metric ton  
REFERENCE PCR AND VERSION NUMBER: Part A: Life Cycle Assessment Calculation Rules and Report Requirements (U.S. Environment, V2.1, 12-12-2018) and Part B: Designated Steel Construction Product EPD Requirements (U.S. Environment, V2.0, 08-26-2020)  
DESCRIPTION OF PRODUCT APPLICATION/USE: Fabricated steel reinforcing bar and merchant bar used in construction  
PRODUCT RSL DESCRIPTION (IF APPLICABLE): N/A  
MARKETS OF APPLICABILITY: North America  
DATE OF ISSUE: June 10, 2022  
PERIOD OF VALIDITY: 5 Years  
EPD TYPE: Product-Specific  
EPD SCOPE: Cradle to gate  
YEAR(S) OF REPORTED PRIMARY DATA: 2020  
LCA SOFTWARE & VERSION NUMBER: Gabi v10.5.1.124  
LCI DATABASE(S) & VERSION NUMBER: Gabi 2012.2  
LCA METHODOLOGY & VERSION NUMBER: TRACI 2.1, EN15804

The PCR review was conducted by: US Environment  
PCR Review Panel  
[epd@ul.com](mailto:epd@ul.com)

This declaration was independently verified in accordance with ISO 14025:2006:  INTERNAL,  EXTERNAL. Cooper McCall, U.S. Environment

This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by: Tonny Consultants  
Thomas P. Gloria, Industrial Ecology Consultants

This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by: Thomas P. Gloria, Industrial Ecology Consultants

**LISTATIONS:**  
EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of the material extraction, nor are they meant to assess human health benefits. EPDs can complement but do not replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type I certifications, health assessments and declarations, environmental impact assessments, etc.

**Accuracy of Data:** EPDs regularly rely on estimations of impacts, the level of accuracy in estimation of effect differs for any particular product line and reported values.

**Comparability:** EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Examples of variations: Different LCA software and background LCI datasets may lead to differences in the assessment or determination of the life cycle stages included.

Source: Nucor

## Requirements

Standard Method of Test for

**Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)**

AASHTO Designation: T 97-14

ASTM Designation: C 78-08



## Process



## Result



# PCR

(Product Category Rule)  
Defined by Program Operator

# LCA

(Life Cycle Assessment)  
Can be simplified  
using automated systems

# EPD

(Environmental Product  
Declaration)

Note: The use of AASHTO specifications is not a Federal requirement.

**Strength**

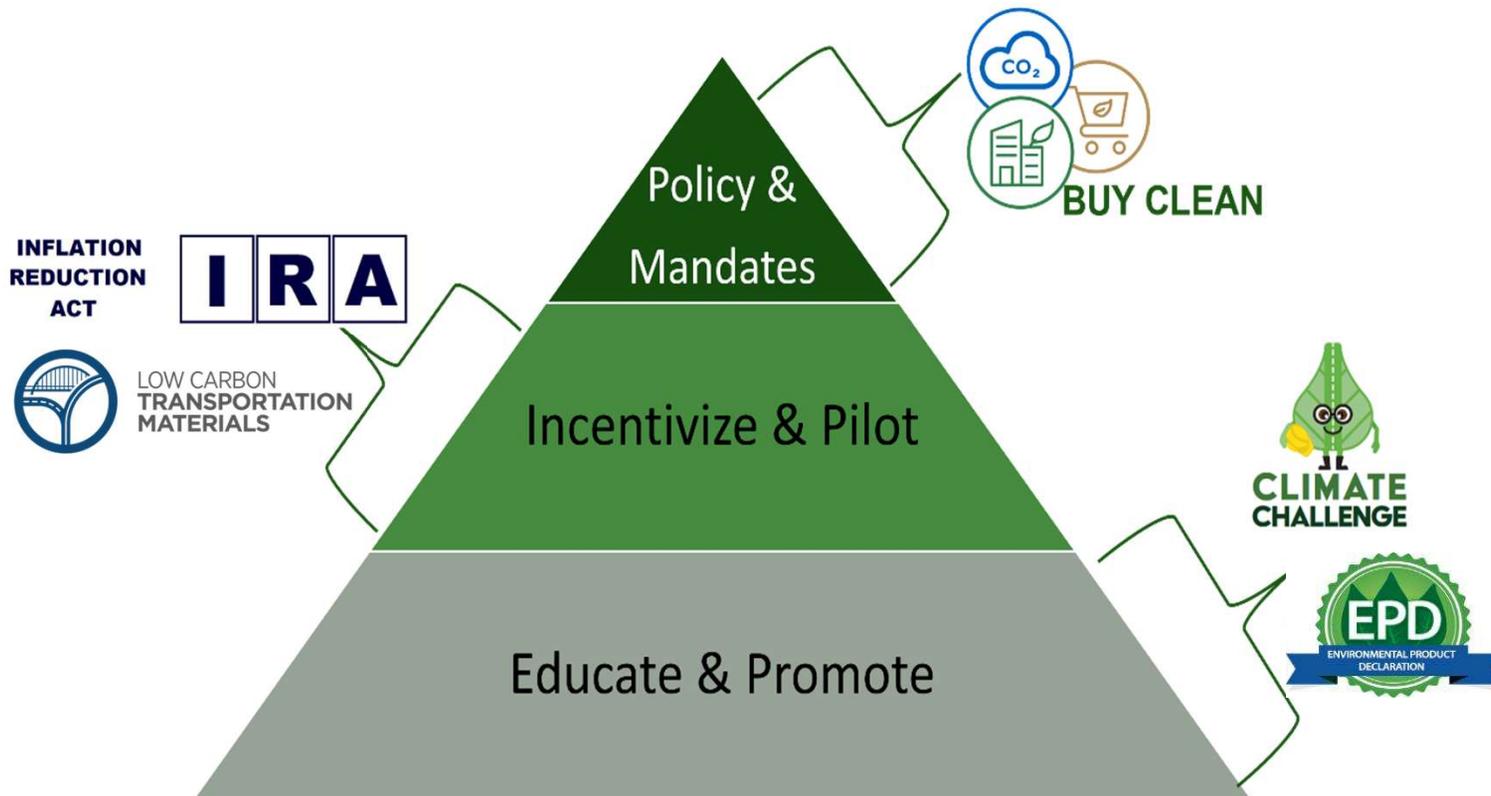
**Sustainability**



# Current FHWA Initiatives



# FHWA building-block approach to achieve embodied greenhouse gas (GHG) emissions reduction





# 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.



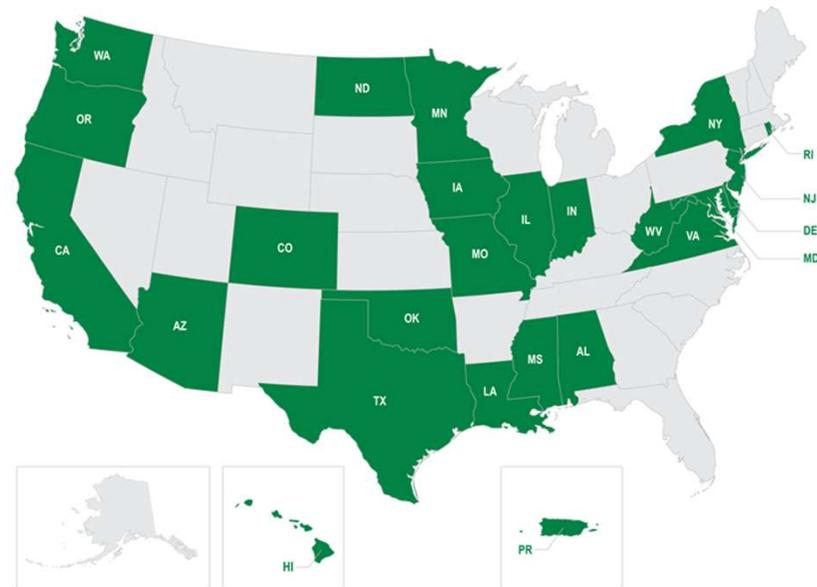
For the latest information, visit the website: <https://highways.dot.gov/climatechallenge>

# FHWA Climate Challenge

\$7.1M awarded to:

- More than 35 projects
- 27 agencies
  - 25 State DOTs
  - 2 local agencies

Technical assistance is being provided to all 27 agencies



<https://www.fhwa.dot.gov/infrastructure/climatechallenge/projects/index.cfm>



# Maryland DOT



## Contact Information: **Chung-Lung Wu**

✉: [cwu4@mdot.maryland.gov](mailto:cwu4@mdot.maryland.gov)

☎: 443-572-5036

## **Darren Swift**

✉: [dswift1@mdot.state.md.us](mailto:dswift1@mdot.state.md.us)

☎: 410-385-4462

**Project 1: Informed Emissions Reduction Strategies for Asphalt and Concrete Paving Projects**

**Project 2: Geoenvironmental and Life Cycle Analysis of Highway Infiltration Berms Constructed with Dredged Sediments.**

### Project Goals:

**Project 1:** To use LCA and EPD to develop sustainable pavement practices, including pavement material and design selection, contract specifications and requirements, that optimize performance and asset life, while also contributing to reduced emissions and impacts in pavement practices at MDOT.

**Project 2:** Provide recommendations on DM and DM blends that can be used for VEBs throughout Maryland.

### Project Tasks:

- **Project 1:** (1) Develop a list of stakeholders, survey questions, beta-tested survey, and finalized survey for distribution, (2) create a final readiness assessment report, and (3) training curriculum on EPDs and LCAs.
- **Project 2:** (1) Characterization and Selection of the Testing Materials, (2) Characterizing Geotechnical Engineering Parameters of VEB DM materials with varying Physical Properties, (3) Evaluation of Environmental Characteristics, (4) Grass Establishment and Growth on VEB DM materials in Greenhouse Mesocosm Experiments, (5) Data Analysis and Recommendation for Final Blend, (6) Final Blend Evaluation, (7) Life Cycle Analysis (LCA), (8) Reporting





## 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

Source: FHWA

# EPDs for Sustainable Project Delivery Participants



Agencies Participating	Amount
Agencies Implementing EDC:	35 (65%)



## EDC-7: EPDs for Sustainable Project Delivery

- ✓ EDC-7 & CC Symposium
- ✓ June 5-6, 2024



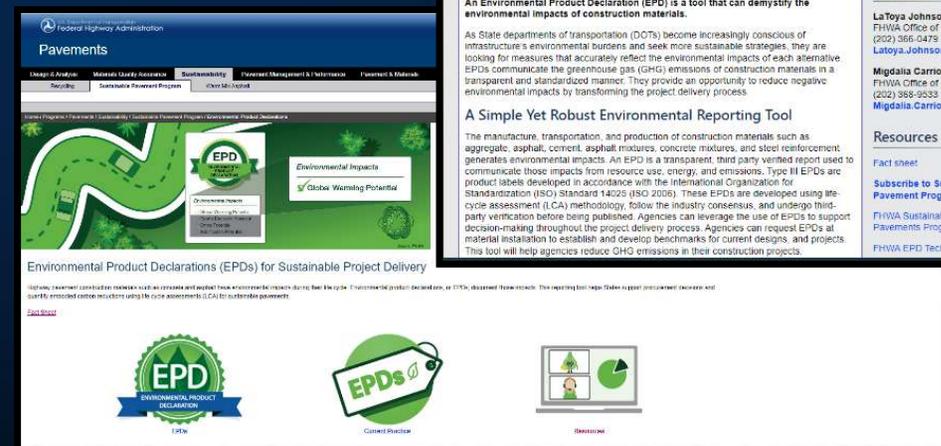
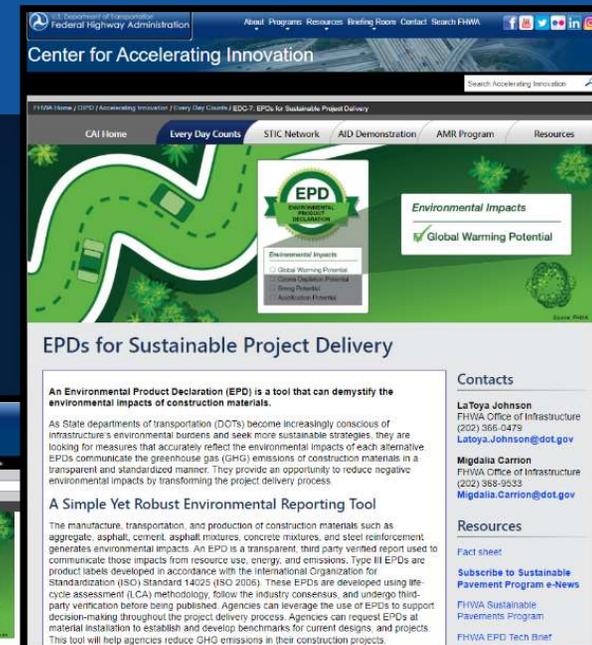
U.S. Department of Transportation  
**Federal Highway Administration**



# 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/>



# Inflation Reduction Act (IRA) of 2022

- Sec. 60112. Environmental Product Declaration Assistance
  - \$250 Million to EPA
- Sec. 60116. Low-Embodied Carbon Labeling for Construction Materials
  - \$100 Million to EPA
- Sec. 60503. Use of Low-Carbon Materials
  - \$2.15 Billion for GSA
- Sec. 60506. Low-Carbon Transportation Materials Grants (23 U.S.C. 179)
  - \$2 Billion for FHWA



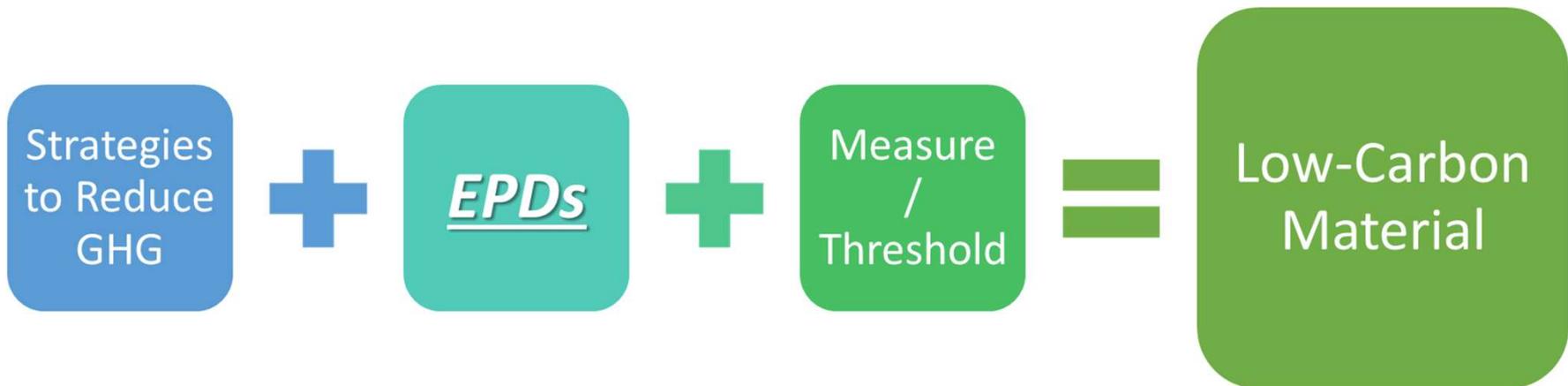
# IRA Section 60506 (23 U.S.C. 179)

- Low-Carbon Transportation Materials and Products
- Amount: \$2 billion to remain available until September 30, 2026.
- Agency: **Federal Highway Administration.**
- Purpose: To reimburse or provide incentives for the use, in projects, of construction materials and products that have substantially lower levels of embodied greenhouse gas emissions associated with all relevant states of production, use, and disposal as compared to estimated industry averages of similar materials or products, as determined by EPA.

# What are “Substantially Lower” Materials?

- Defined by EPA Interim Determination dated 12/22/2022
- 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)

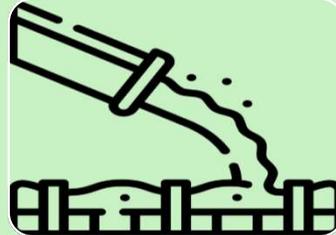
# What are Low Carbon Materials?



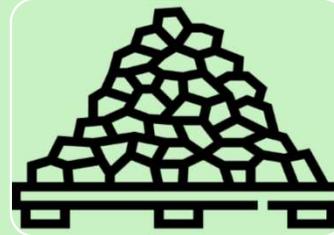
# Examples of Strategies for Lower Carbon Concrete Mixtures



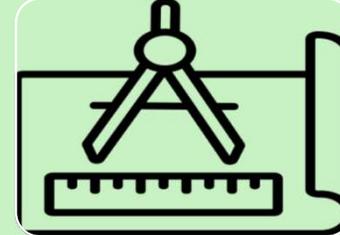
Strategies  
targeting the  
cementitious  
binder



Strategies  
targeting the  
concrete  
mixture to  
optimize  
binder content



Reducing the  
embodied  
carbon  
content of  
aggregates

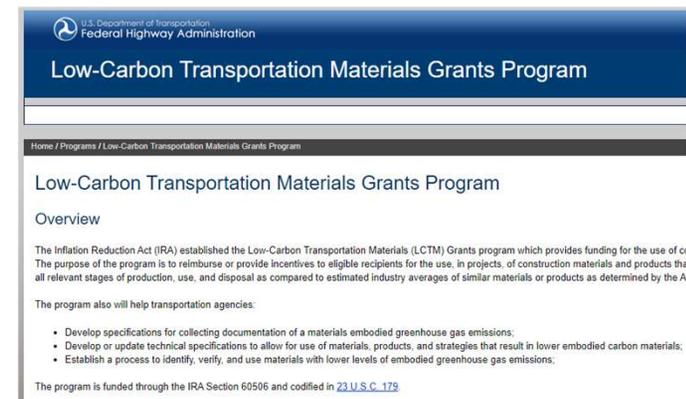


Performance  
specifications  
for concrete  
mixtures



# FHWA Resources

- FHWA Inflation Reduction Act Information and Fact Sheets
  - <https://www.fhwa.dot.gov/inflation-reduction-act/>
- Low Carbon Transportation Materials Grants Program Information
  - <https://www.fhwa.dot.gov/lowcarbon/>



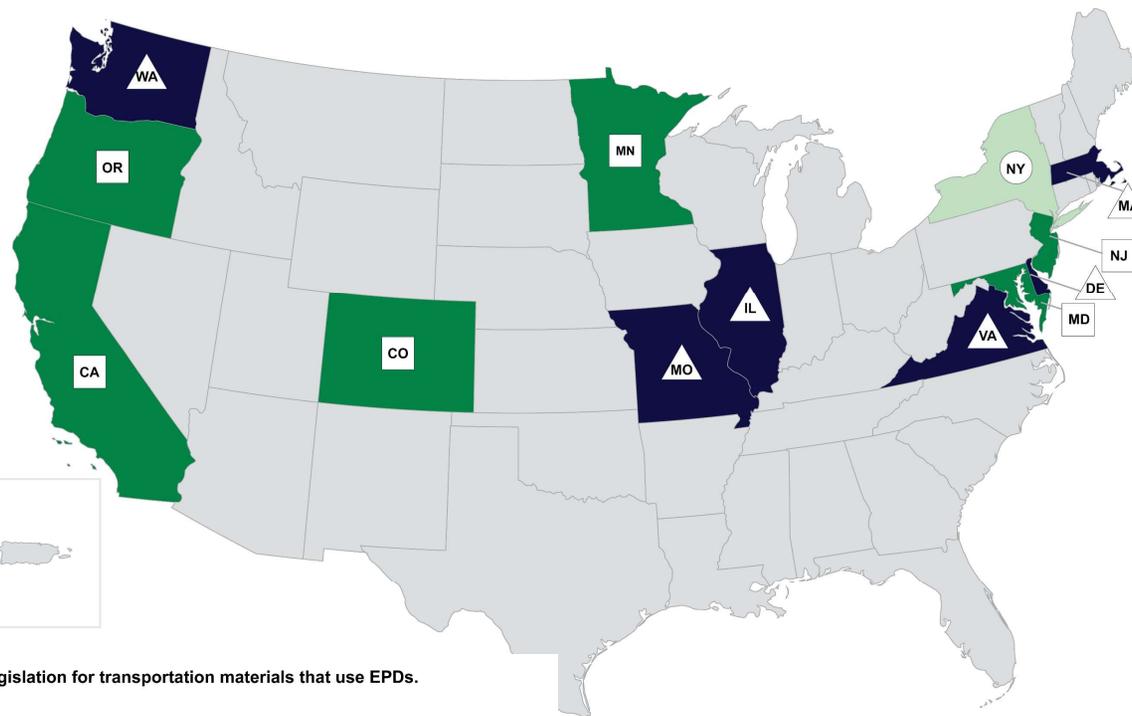


# E.O. 14057 - Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability (Dec. 8, 2021)- [link](#)

## Sec. 303. Buy Clean.

- Establishes Buy Clean Task Force to:
  - Identify and prioritize pollutants and materials to be covered under a Buy Clean policy, considering relevant and available data, including those from Environmental Product Declarations, and consistency with existing environmental reporting requirements.
  - Make recommendations to increase transparency of embodied emissions, procedures for auditing environmental product declarations and verifying accuracy of reported emissions data.
  - Make recommendations for financial and technical assistance to support domestic manufacturers in enhancing capabilities to report and reduce embodied emissions.
  - Make recommendations of pilot programs that incentivize Federal procurement of construction materials with lower embodied emissions.

# Buy Clean Policies at the State Level



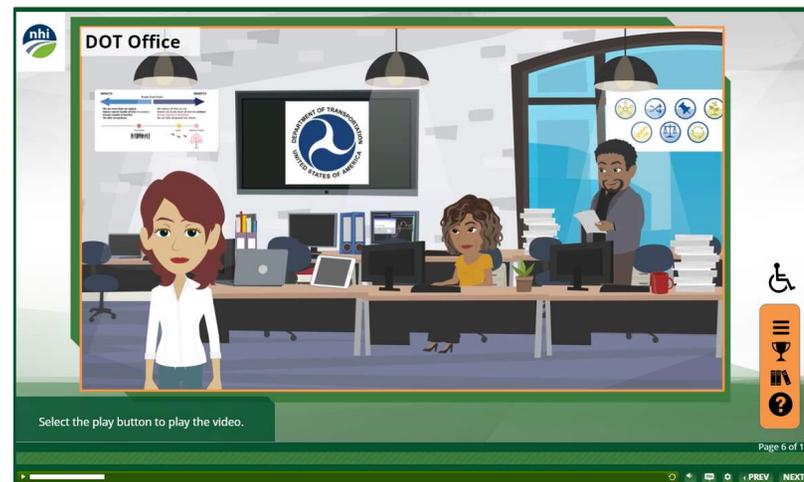
Information collected from  
State legislative websites.

-  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.

# *NHI-131134 Integrating Sustainability into Infrastructure Decision-Making – **Now Available!***

- 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

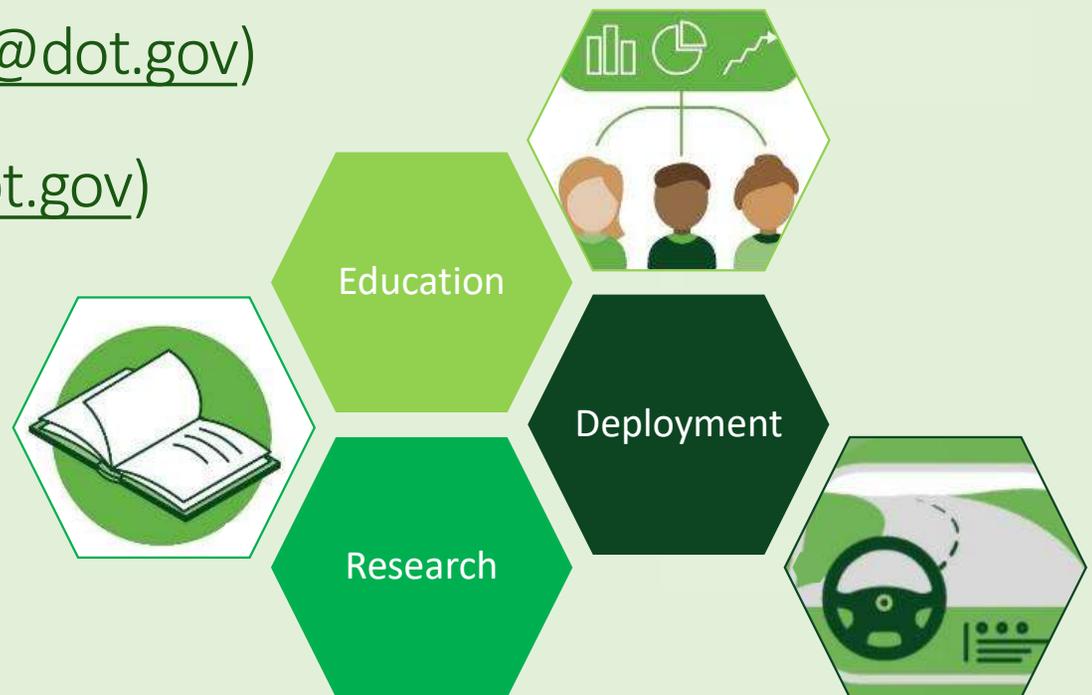
EDC 7- EPD for Sustainable Project Delivery

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Migdalia Carrion ([Migdalia.Carrion@dot.gov](mailto:Migdalia.Carrion@dot.gov))

Jennifer Albert ([Jennifer.Albert@dot.gov](mailto:Jennifer.Albert@dot.gov))

# Thank You!



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