Environmental Product Declarations (EPDs)
An Update on the Colorado DOT's Benchmarking Efforts

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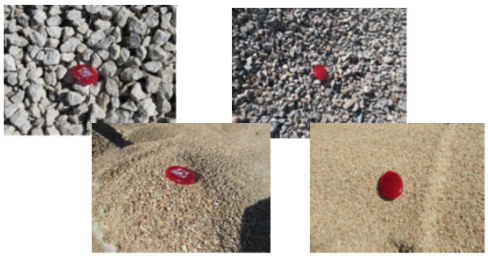
CO/WY Chapter – American Concrete Pavement Association

CDOT & Industry Have Been Proactive for Years

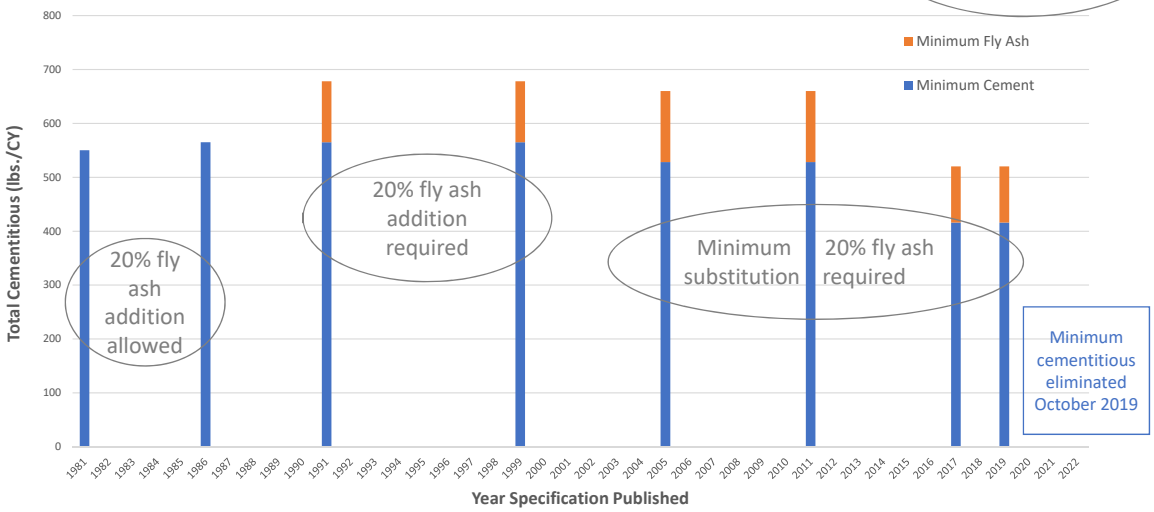
- Pavement Design – Adoption of Pavement ME
- Materials Selection and Mixture Design Specifications
  - Aggregates
  - Cementitious Materials

Optimized Gradations



CDOT Concrete Pavement Minimum Cementitious Contents

25%+ reduction in min. cement content from 1999 to 2017

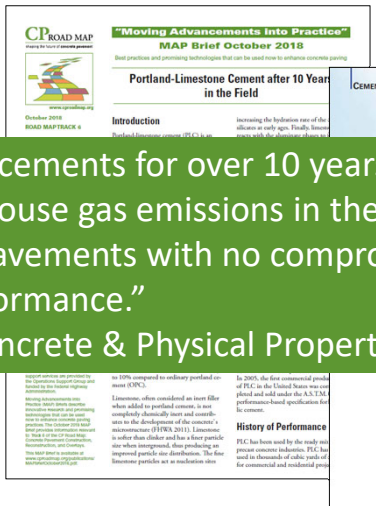


CDOT Specifications – PLC allowed since 2008

- ASTM C1157 GU used initially
- ASTM C595 Type IL introduced in fall 2014

1st CDOT Paving Project w/ PLC
US 287 (Ports to Plains route) in eastern CO

PLC Allowed in CDOT Specs since 2008



"Using portland limestone cements for over 10 years allows Colorado to reduce greenhouse gas emissions in the construction of concrete pavements with no compromise in quality and long-term performance."
Eric Prieve, CDOT Concrete & Physical Properties Engineer

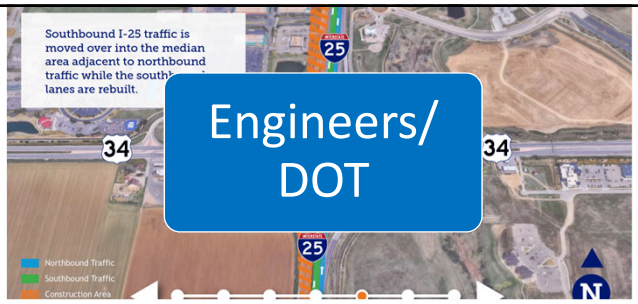
1,500+ Lane-Miles of Concrete Pavement w/ PLC

What was being accomplished with these changes?

- Improved durability
- Lower materials cost
- Encourage Innovation
- Lower environmental impact
- Prevents excessive over-design
- Smoother pavements

Intentional or not, we were headed on the path toward…

Performance Engineered Mixtures (PEM)!



Engineers/ DOT

Was there meaningful communication between all of these groups?

Contractors

Legislators

THE DENVER POST

Denver among top 10 worst U.S. cities for hazardous air pollution, 2 new studies say

EPA tallies show Denver residents inhaled elevated pollution on more than 260 days a year for the past two years

In this Wednesday, March 6, 2019, photograph, the skyline is shrouded as pollution fills the air over Denver.

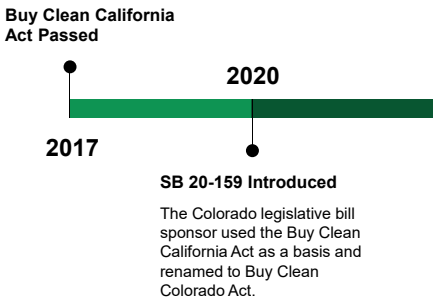
By **BRUCE FINLEY** | bfinley@denverpost.com | The Denver Post
January 30, 2020 at 6:00 a.m.

"People also are breathing bad air regularly in other cities along Colorado's Front Range, from Colorado Springs to Fort Collins, according to Environmental Protection Agency records."

"And climate warming is expected to intensify air pollution, federal scientists warn, because heat speeds the formation of ground-level ozone and boosts the frequency and severity of wildfires, which infuse more particles into smog."

Source: The Denver Post, January 30, 2020

Buy Clean Colorado: Background



Graphic Source: Colorado Department of Transportation

What was the impetus for EPD legislation?

Our Challenge…

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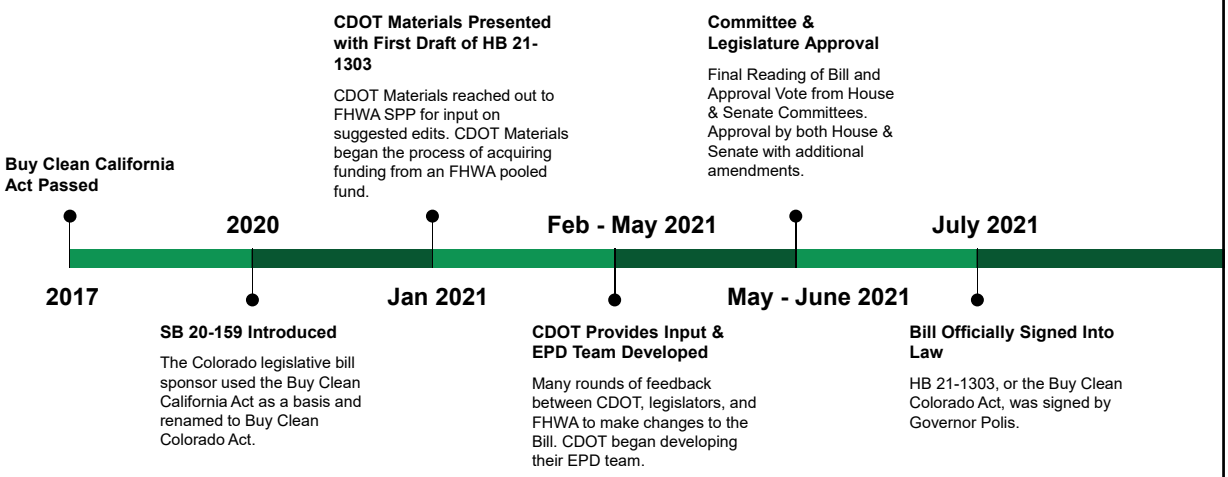
Buy Clean Colorado: Background



Graphic Source: Colorado Department of Transportation

Buy Clean Colorado: Working with Legislature

CDOT worked several months with bill sponsor from proposal through acceptance by legislative committee. CDOT gathered input from the FHWA Sustainable Pavements Program and other Agencies to **shape the bill**.

- Changes CDOT Materials requested:
  - Divide the bill into 2 sections: vertical construction & horizontal construction
  - Allow more time to collect EPDs for benchmarking before establishing limits
- Final Content:
  - Based on CDOT's feedback, bill divided into separate sections for vertical and horizontal construction

Content Source: Colorado Department of Transportation

Buy Clean Colorado

- HB 21-1303 incorporated into Colorado Revised Statutes in July '21
  - 24-92-117 – Office of the State Architect
  - 24-92-118 – Colorado Department of Transportation
- Requires CDOT to collect EPDs per ISO 14025 on eligible projects for certain eligible materials including:
  - Asphalt and Asphalt Mixtures
  - Cement and Concrete Mixtures
  - Steel
- CDOT must use collected EPDs to develop a policy establishing maximum Greenhouse Gas emissions for each eligible material
- EPD submittal requirements detailed in "Buy Clean Colorado" Specification

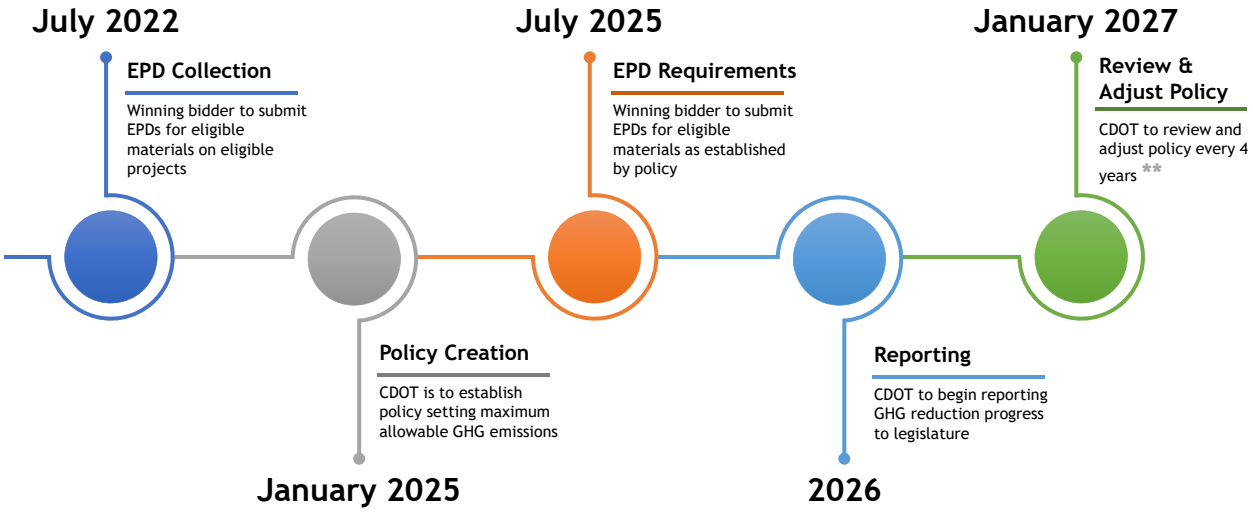
HB 21-1303: Potential Benefits

Implementation of this EPD program will provide the following potential benefits:

- Partnership with the statewide Colorado Greenhouse Gas (GHG) Pollution Reduction Roadmap
- Alignment with CDOT's GHG Pollution Reduction Proposed Standards
- Compliance with HB 21-1303 by reducing GHG of CDOT projects over time
- Supply CDOT with information to make more informed and environmentally responsible decisions
- Collaboration with material suppliers and contractors to quantify and potentially reduce their environmental impacts
- Transparency to the public that CDOT is moving towards more sustainable infrastructure

Content Source: Colorado Department of Transportation

HB 21-1303 Timeline



Graphic Source: Colorado Department of Transportation

CDOT's New EPD Specification

June 2, 2022

REVISION OF SECTION 101 and 106
ENVIRONMENTAL PRODUCT DECLARATIONS

Sections 101 and 106 of the Standard Specifications shall include the following:

Add the following definitions to Subsection 101.02:

Environmental Product Declaration: An environmental declaration providing quantified environmental data using predetermined parameters and, where relevant, additional environmental information. ISO14025 refers to these as a Type III Environmental Declaration.

Product Category: A group of products that can fulfill equivalent functions (ISO14025).

Product Category Rule: A set of specific rules, requirements, and guidelines for developing Type III environmental declarations for one or more product categories (ISO14025).

Section 106 shall include the following:

106.13 Environmental Product Declaration (EPD) Materials Submittal Requirements:

The Contractor shall submit an Environmental Product Declaration (EPD) for the following materials to be utilized on this project.

(1) Asphalt and Asphalt Mixtures,
(2) Cement and Concrete Mixtures,
(3) Steel.

The EPD submittal shall be per the Environmental Product Declarations Protocol document as published in the Appendix of the CDOT Field Materials Manual relevant to the project. The EPD Protocol Document shall be considered a Contractual Document for this project.

All costs associated with the development of and submittal of an EPD and any other work associated will not be paid for separately but shall be included in the relevant bid item, or constituent material prices.

- All details included in CDOT's Field Materials Manual
- $3M minimum project cost
- Defines bid items requiring EPD submittal & relevant quantity limits
- Addresses portable batch plants

CDOT Bid Items Currently Requiring EPDs

Table 1. Bid Items Requiring EPD Submittal

Item Number Category	Item Description	Included Item Number / Range	Interpretation
206	Structure Backfill (Flow-Fill)	206-00065	EPD submittal required for the flow-fill (concrete) design.
310	Hydraulic Cement	310-00900	EPD submittal required for the cement.
403[1]	Asphalt Mixtures (HMA/SMA/WMA)	403-09210 through 403-96660	EPD submittal for each asphalt mixture design and plant location required. If 411 - Asphalt Cement is paid separately, it shall be included in the 403 EPD submittal item. For portable Plant EPD Guidance, see footnote.
412[1]	Portland Cement Concrete Pavement (PCCP)	412-00200 through 412-01500; 412-06000; 412-06060	Separate EPD submittals for concrete, dowel bar, and reinforcing steel items are required. For portable Plant EPD Guidance, see footnote.
503	Drilled Shafts	503-00012 through 503-00102	Separate EPD submittals for concrete and reinforcing steel items are required.
504	Walls (Cast in Place)	Cast in place 504 items containing concrete, reinforcing steel, or both.	Separate EPD submittals for concrete and reinforcing steel items are required.
601	Concrete (All Classes)	601-01000 through 601-05900	Separate EPD submittals are required for each class of concrete and mix design for each supplier.
602	Reinforcing Steel	602-00000 through 602-00025	Separate EPD submittals are required for each mill supplying steel.
604	Inlets/Drainage Structures (Cast in Place)	604-00305 through 604-19515; 604-20000 through 604-39035	Separate EPD submittals for concrete and reinforcing steel items are required.
606	Guardrail and Bridgerail (Cast in Place)	606-00710 through 606-00944	Separate EPD submittals for concrete and reinforcing steel items are required.
608	Concrete Sidewalk & Bikeway	608-00000 through 608-00012; 608-00020 through 608-00040; 608-00350 through 608-00500	EPD submittal required for concrete, or asphalt mixtures.
608	Bituminous Sidewalk & Bikeway	608-01000 through 608-01500	EPD submittal required for concrete, or asphalt mixtures.
609	Curb and Gutter	609-20000 through 609-71000	EPD submittal required for concrete.
610	Median Cover Material	610-00010 through 610-00040	EPD submittal required for concrete, or asphalt mixtures.

Concrete Related Bid Items

CDOT Bid Item Quantity Limits

Table 2. Bid Item Quantity Limits

Item Number Category	Item Description	Quantity Limits	Unit
206	Structure Backfill (Flow-fill)	50	CY
310	Hydraulic Cement	150	Ton
403	Asphalt Mixtures (HMA/SMA/WMA)	500	Ton
412	Portland Cement Concrete Pavement (PCCP)	1,000	SY
601	Structural Concrete (All Classes)	50	CY
602	Reinforcing Steel	15,000	LB
608	Concrete Sidewalk & Bikeway	250	SY
608	Bituminous Sidewalk & Bikeway	500	Ton
609	Curb and Gutter	1,000	LF
610	Median Cover Material	4,000	SF

Concrete Related Bid Items

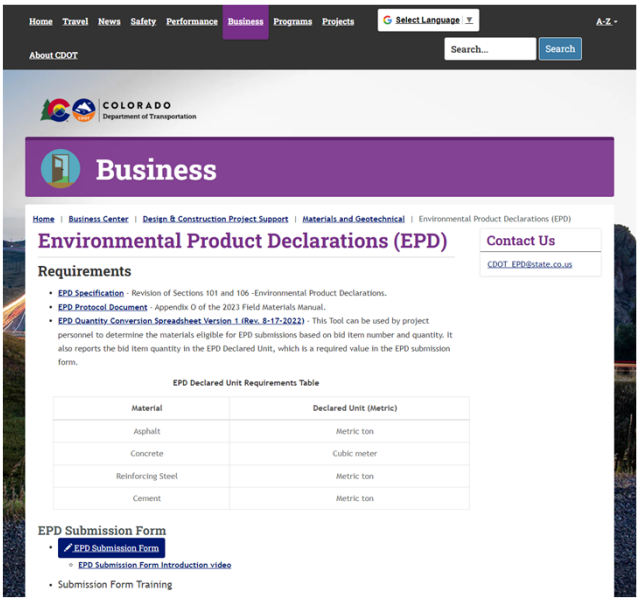
Status of EPD Collection: Summary

- 56 projects advertised (through early January) that contain EPD specification & are eligible for EPD collection
- CDOT received 29 EPDs & expecting more submissions soon
- Additional categories to be added:
  - Structural Steel
  - Precast & Prestressed concrete

Content Source: Colorado Department of Transportation

CDOT EPD Resources

- EPD Specification
- EPD Protocol Document
- EPD Quantity Conversion SS
- EPD Submission Form & Training
- Reference Documents
- Presentations & Workshops
- Conference Agendas
- White Paper



https://www.codot.gov/business/designsupport/materials-and-geotechnical/epd

Expected Changes Coming Soon…

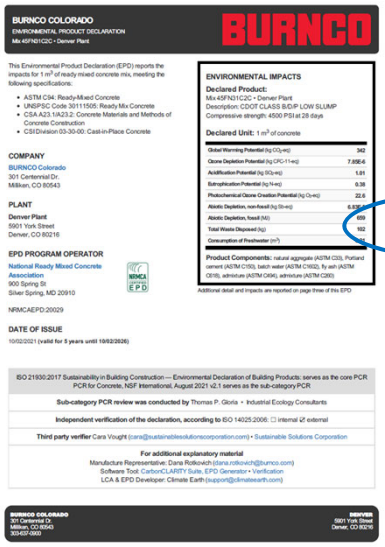
Bid items to be added

- Steel pilings
- Walls (expand to include precast)
- Slope & ditch paving
- Structural steel
- Reinforced concrete pipe/end sections/culverts
- Inlets/drainage structures (expand to include precast)
- Guardrail & Bridgerail (expand to include precast)
- Prestressed concrete structures
- Drainage pipes

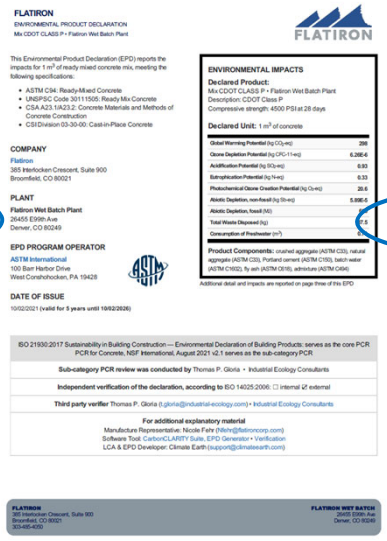
Future Requirements…

- Additional bid items
- Uncertainty factors may be applied to GWP values shown in EPDs to account for non-facility specific data used when developing them
- Ongoing outreach with industries producing and placing eligible materials
- Additional materials may be added
  - Cold-rolled steel elements (such as guardrail & corrugated metal pipe)

Example EPDs for CDOT Class P (Paving) Concrete
(Not collected through CDOT program)



- CDOT B/D/P
- Impacts for 1 m^3
- 4,500 psi @ 28 days
- GWP: 342 kg CO_2-eq
- EPD Program: NRMCA
- 3rd party verifier: Sustainable Solutions Corp.
- LCA & EPD Developer: Climate Earth



- CDOT P
- Impacts for 1 m^3
- 4,500 psi @ 28 days
- GWP: 298 kg CO_2-eq
- EPD Program: ASTM
- 3rd party verifier: Industrial Ecology Consult.
- LCA & EPD Developer: Climate Earth

Next Steps: FHWA Climate Challenge

CDOT was granted $312,000 & intends to use on the following projects:

Project 1: Continued support for compliance with HB 21-1303 (future industry outreach, improvements to EPDs and PCRs).

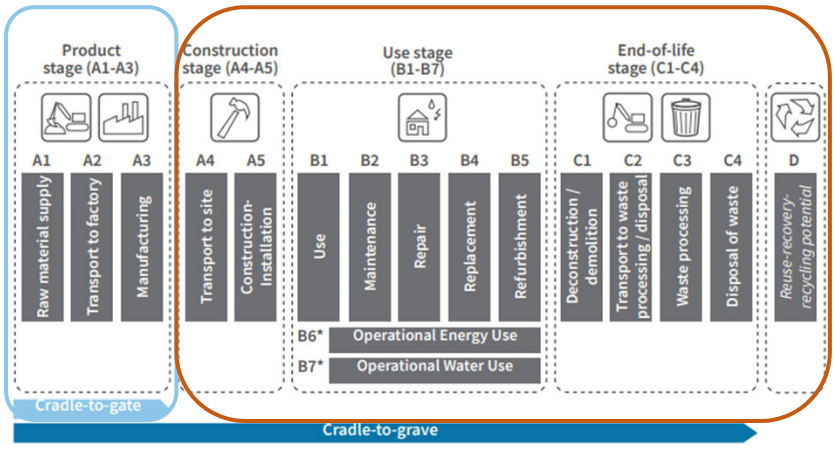
Project 2: Data analyses and methodology to establish GWP limits based on EPD data CDOT collects between now and 2025 (how to categorize materials, how to identify outliers and handle uncertainty, and developing documentation of this process) - In collaboration with CU Boulder.

Project 3: Beyond A1-A3 (gaining familiarity with lifecycle thinking and the LCA Pave tool).

CLIMATE CHALLENGE

Content Source: Colorado Department of Transportation

EPDs Measure Cradle to Gate Impacts



*Operational carbon stages that are typically excluded from life cycle assessments focused on embodied carbon.

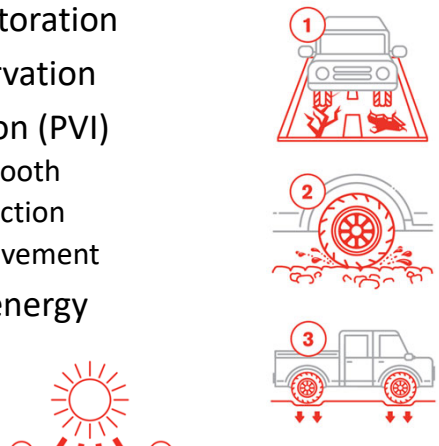
Figure 1. Life cycle stages for building products, based on EN 15978:2011 and ISO 21930:2017.

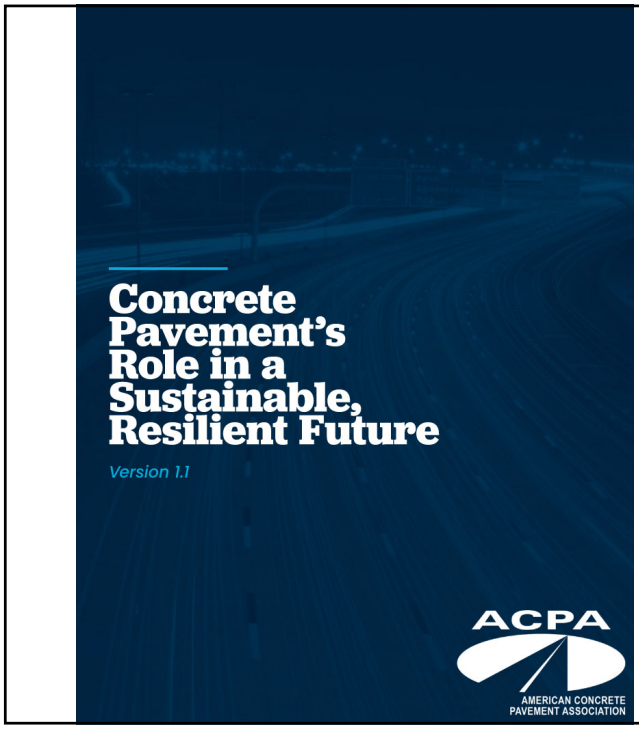
Graphic Source: Carbon Leadership Forum (CLF)

Substantial portion of impacts are not captured through EPDs

Beyond A1-A3: Reducing Gate to Grave Impacts

- Pavement preservation/restoration
- Concrete overlays as preservation
- Pavement Vehicle Interaction (PVI)
  1. Roughness – bumpy or smooth
  2. Texture – abrasiveness/traction
  3. Deflection – bending of pavement
- Albedo - measure of solar energy reflected by earth's surface





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Questions?

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Huge thanks to Hailey Goodale for providing presentation content & insights!
Please reach out to her directly with additional questions.

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