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Development of Environmental Product Declarations (EPDs) for Sustainable Pavement Procurement

APPLIED RESEARCH & INNOVATION BRANCH

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COLORADO
Department of Transportation

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16. Abstract

The Colorado Department of Transportation (CDOT) funded this project to assess the current state-of-the-practice of EPDs in pavement material manufacturing; to educate stakeholders regarding pavement life cycle assessment (LCA) and EPDs; and to help develop protocols CDOT and pavement material producers can use to integrate EPDs that are uniquely suited to Colorado. The tasks of this study included a literature review, workshops for CDOT and industry partners, and recommendations for development of EPD protocols. The first workshop focused on internal CDOT employees, including pavement and materials engineers, project engineers, and estimators. The second workshop focused on external stakeholders, including contractors, materials producers, and trade association representatives. A summary of the feedback and discussions from the workshops are included in this report.

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I. Executive Summary

This project aims to assist CDOT with the initial implementation of Section 118 of Colorado HB 21-1303, “The Buy Clean Colorado Act”. The bill requires contractors to submit Environmental Product Declarations (EPDs) for asphalt and asphalt mixtures, cement and concrete mixtures, and steel installed on CDOT projects. Ultimately, the bill instructs CDOT to establish greenhouse gas (GHG) emission limits for these materials, and contractors on CDOT construction projects will need to comply with the limits established by CDOT. The objectives of this study were to assess the current state-of-the-practice of EPDs in construction material manufacturing; to educate stakeholders regarding life cycle assessment (LCA) and EPDs; and to help develop protocols uniquely suited to Colorado that CDOT and material producers can use to integrate EPDs into the framework of Buy Clean Colorado.

The tasks of this study included a literature review, workshops for CDOT and industry partners, and recommendations for development of EPD protocols. The first workshop focused on stakeholders internal to CDOT, including pavement and materials engineers, representatives responsible for procurement and environmental decision making, and project managers. The second workshop focused on external stakeholders, including contractors, materials producers, engineers, and trade associations. The communications and outcomes from the two workshops were used to help develop and refine the protocols and specifications for CDOT’s initial launch of their EPD program. The lessons learned will also help CDOT develop benchmark limits for the next stage of Buy Clean Colorado.

II. Literature Review

A. Environmental Product Declarations

Procurement of construction and pavement materials is one of the processes in the life cycle of transportation infrastructure projects. State highway agencies in the U.S. are starting to require quantified environmental data summary reports, namely Environmental Product Declarations (EPDs), for construction materials. An EPD is a standardized label that resembles the nutrition statement on a food product, presented in a scientifically sound way to communicate the environmental impacts (e.g., resource use, energy, emissions) to either all or part of the life cycle of a product. To produce an EPD, life cycle assessment (LCA) methodology is used in which the life cycle environmental impacts of a material, product, activity, or system are quantified. When performed in accordance with International Organization for Standardization (ISO) standards for LCA, the product labels are called Type III Environmental Declarations or EPDs under ISO Standard 14025 (ISO 2006), and the more recently published ISO Standard 21930 (ISO 2017) that was developed specifically for civil infrastructure construction materials. Procurement of more environmentally sustainable materials for construction projects can be supported using EPDs as EPDs help decision makers and agencies make informed decisions based on quantified life cycle impact results for the construction materials.

Currently, most EPDs for construction materials only represent the material production stage of the life cycle of the project, which is referred to as “cradle-to-gate”. However, these cradle-to-gate EPDs can be used as quantitative comparisons of environmental indicators and serve as a mechanism for measuring improvements in environmental impacts during the manufacture of materials. Common construction materials for which cradle-to-gate EPDs exist are cement, asphalt mixtures, concrete mixtures, steel, lumber, and aggregates. Figure 1 indicates where cradle-to-gate EPDs fit in the life cycle of a civil infrastructure project, showing that it includes raw material supply, transport of the raw material within the manufacturing supply chain, and product manufacturing. The ISO terminology is presented in Figure 1, where Modules A1 through A3 are referred to as the “production stage”.

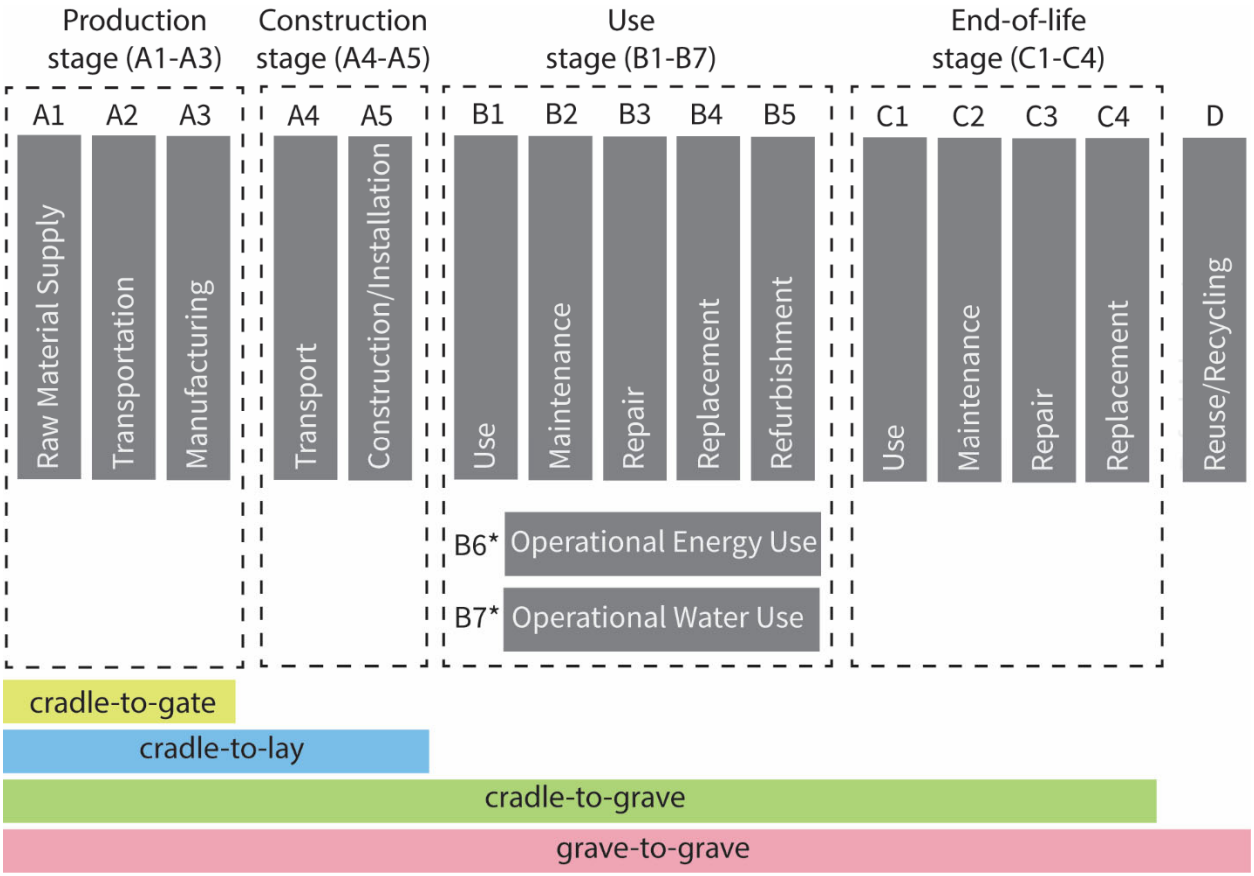

Figure 1. Life cycle stages for building products (adopted from ISO 21930) with boundary conditions for LCA scopes

B. Buy Clean Colorado

Colorado HB 21-1303 “Buy Clean Colorado Act” directs the Office of State Architecture and CDOT to establish policies that reduce greenhouse gas emissions over time by accounting for and limiting the global warming potential (GWP) of key construction materials in state-funded building and transportation projects. The bill passed the state legislature on June 7, 2021 and took effect on July 1, 2022. According to the bill sponsor, State Rep. Tracey Bernett, the goal of the bill is to encourage manufacturers of construction products to reduce their greenhouse gas (GHG) emissions, and ultimately require architects, engineers, and contractors to specify greener construction materials where those materials are practical and economical. The office of the State Architect is responsible for Section 117 of the bill, Colorado Revised Statutes 24-92-117, which covers building construction, and CDOT is responsible for Section 118 of the bill, Colorado Revised Statutes 24-92-118, which covers transportation construction to include roads, highways, and bridges. The eligible construction materials listed under Section 118 of the bill are asphalt and asphalt mixtures, cement and concrete mixtures, and steel (Colorado House of Representatives, 2021).

HB 21-1303 sets forth a timeline for implementation of the law. For CDOT projects advertised on or after July 1, 2022, the winning prime contractor(s) are required to submit EPDs for pre-

established bid items. Starting on July 1, 2022, CDOT will have two and one-half-years to gather GWP data from collected EPDs. The gathered data will be used to benchmark environmental emissions from construction materials and to develop maximum GWP limits for each eligible material. By January 1, 2025, CDOT must establish a policy with GWP limits on eligible materials. CDOT may create subcategory limits within the eligible material categories (e.g., different limits for different strength concrete mixtures). By July 1, 2025, the winning prime contractor will be required to submit EPDs for eligible materials and those EPDs must comply with the maximum GWP limits established by the CDOT policy. Starting on January 1, 2027, and every four years thereafter, CDOT will be required review the EPD policy and adjust the policy to reflect industry conditions, as necessary. It should be noted that once established, the EPD policy cannot be adjusted to be less stringent for any material.

The CDOT EPD policy will request that facility-specific data, as opposed to product-specific or industry-wide data, be supplied with the submitted EPDs. A facility-specific EPD reports the environmental profile of a specific product (e.g., a specific asphalt mixture produced at a specific facility); a product-specific EPD would represent the environmental impacts for a specific product and manufacturer across multiple facilities; and an industry-wide EPD uses weighted input data to produce results that are representative of average emissions for that product across all producers (Rangelov et al. 2021, Carlisle et al. 2021). Facility-specific EPDs are preferred for the CDOT initial data gathering since they typically have higher resolution and are better suited to derive meaningful regionally applicable benchmarks. There are important differences in environmental impacts between regions, such as differences from electricity production, sources and methods of extraction for raw materials, material processing methods, and transportation modes and distances from extraction to production locations. The facility-specific data gathered by CDOT will be used to establish the GWP limits or benchmarks for eligible materials in future years.

III. Workshop Outcomes

A. Internal CDOT Staff Workshop (Workshop 1)

Workshop 1 was held on June 8, 2022, at CDOT Headquarters, and it focused on the needs of CDOT internal staff, i.e., pavement engineers, construction engineers, project managers, and estimators. There were approximately 22 people attending in person and another 62 individuals participating on-line. The agenda for the meeting can be found in *Appendix 1.* All the presentations and recordings of the presentations from the meeting can be found on the CDOT EPD website.

The goal of the workshop was to educate CDOT project engineers and consultant project engineers on the implementation of the new CDOT specification and protocol that will require EPDs for key construction materials. Part of the workshop included a Q&A session where CDOT personnel asked the EPD project team questions about Buy Clean Colorado and the CDOT EPD protocol. The questions were either answered either during the day of the workshop

or afterwards via email. Some of the key questions from CDOT personnel and the associated answers are summarized below.

- Q: Was that $3M cost limit on the bid items or $3M total project cost? A: The $3,000,000 project cost limit includes all bid items, but not CE Indirect costs or costs related to Force Accounts (FA).
- Q: Please clarify that the initial rollout of this will not apply to locally administered projects. A: For initial rollout, locally administered projects will not require EPD submittals. However, EPD requirements may apply to Local Agency projects in the future.
- Q: Will the EPD be required in order for the project to go to Advertisement? A: EPDs will not be required at the time of Advertisement, but they will be required to be submitted a minimum of two weeks prior to materials placement, or before they are permanently incorporated into the work.
- Q: Who will be accepting the EPDs and how will they be submitted? A: Currently, contractors will submit EPDs and EPD data through a Google form that is linked on the CDOT EPD website. Eventually, CDOT plans to incorporate EPD submission into the OnBase system, but that is currently not up and running.
- Q: Will there be additional requirements for the final documentation checklist? A: Not at this time, but additional final documentation requirements may be implemented in the future.
- Q: What happens if a contractor fails to submit the EPDs? Is nonpayment of the bid item the enforcement or will work not be allowed without it? A: At this time, there are no established forms of enforcement. We hope we will receive the EPDs required on time, but if that is not the case, we may explore options for enforcement/non-compliance consequences.
- Q: Should there be a CDOT Pay Item for compliance with EPD submission that levels the playing field for smaller and bigger contractors? A: Pay Items were discussed, but not supported due to complexity and number of EPDs that will be collected on projects. There simply was no way to quantify the number and associated costs that could be used to estimate a pay item. It was decided that the cost to generate an EPD would be best captured if included in the cost of the work, similar to mix designs, etc. EPD requirements will be business as usual going forward.

B. External Stakeholder Workshop (Workshop 2)

Workshop 2 was held on August 18, 2022, at the Byron White Club on the CU-Boulder campus, and it focused on industry stakeholders, i.e., practitioners, suppliers, contractors, engineers, industry trade organizations, etc. There were approximately 55 people in attendance and no on-line option was offered (to encourage maximum in-person attendance). The agenda for the meeting can be found in *Appendix 2.* All the presentations and recordings of the presentations from the meeting can be found on the CDOT EPD website.

The goal of the workshop was to inform industry stakeholders and to obtain the industry perspective about the new CDOT EPD specification and protocol. The workshop began with a keynote speech from Representative Tracey Bernett, the lead sponsor of HB 21-1303. The workshop consisted of presentations from the CDOT team responsible for developing the EPD protocols and industry trade group representatives. There was a Breakout Session where three industry groups (asphalt, concrete, and precast/steel) were able to ask specific questions and voice their concerns. The workshop concluded with a panel discussion featuring Joep Meijer (EPD subject matter expert), Craig Wieden (CDOT EPD team lead), and Brian Dobling (FHWA representative).

The discussions and concerns of the Breakout Sessions for each industry group are summarized below.

1. Asphalt Breakout Session

- Recommend clear requirements for acceptable submittals for contractors so that multiple EPD submittals and corrections are not needed for the same material.
- Will the asphalt EPD represent the contractor's submitted mix design or the adjusted Form 43 that the mix is to be produced at? CDOT response: the EPD should represent the contractor's submitted mix design.
- There's some uncertainty in the NAPA EPD tool on how lime should be handled. Some applications list lime as an aggregate and some list it as an additive.
- CDOT should look for ways to help prime contractors work together with their subcontractors and suppliers to meet the EPD requirements.
- We would like to ensure that EPD benchmarks do not constrain improvements and options for mix changes, such as balance mix design, increased RAP content, liquid lime, and warm mix additives.
- An informal poll of industry participants asked how and where are EPDs currently being or planned to be generated. Participants stated EPDs were generated by Environmental Managers, Estimators, Quality Groups, and Operations Groups within the various companies.

2. Concrete Breakout Session

- Industry would like to have a feedback loop while CDOT is setting benchmark limits, possibly in the form of quarterly meetings.
- There should be some form of statistical analysis to determine outliers and uncertainty.
- Alternate delivery projects could have different materials if more innovative practices are used.
- The group discussed options for sub-categories for different concrete mixtures, for example PLC mixes, Type I/II mixes, Type V mixes, etc.
- The impacts of mobile batch plants on EPDs are unknown and more data is needed to understand EPD differences.
- The two-week timing deadline might be difficult since mixes are sometimes not approved within 2 weeks of placement.

- Projects near state boundaries may have supply issues since the suppliers might be over the state line and therefore, not have any EPDs developed for their materials.
- CDOT is requesting facility specific EPD data, especially during the 2-year data collection period. There are concerns about providing facility-specific cement plant data concerns since there currently is only one cement plant in Colorado that has facility-specific EPDs for cement.
- It can be difficult for CDOT to communicate to concrete producers and suppliers who are not members of the trade associations.
- In addition to cement, CDOT is concerned that many concrete suppliers use industry averages (not facility specific) for their aggregate EPD data.

3. Precast/Steel Breakout Session

- Rebar is currently included in the CDOT EPD protocol. Precast concrete products are expected to be added in Summer 2023. The timeline for inclusion of structural steel products is unknown.
- There was discussion about scaling a precast EPD for one product and extending it to other products. It was asked if there could be a GHG factor per mass of a precast product that could be extended to multiple products.
- When should an EPD for precast most likely be provided? CDOT response: it would make sense for a precast EPD to be included in the bill of lading from the precast plant.
- There are concerns from the rebar industry about the existing steel PCR including how to handle rebar epoxy coating, external fabricators, and vagueness in the PCR.
- LCA can be complicated, and there are concerns that some people might try to game the system.
- There are concerns of a bottleneck of third-party verification of concrete EPDs. ASTM and NRMCA seem to be the only organizations doing third-party verification of precast.

IV. Conclusions and Recommendations for CDOT EPD Protocols and Benchmarks

While the initial CDOT EPD protocol was drafted before both the Internal CDOT Workshop (Workshop 1) and the Industry Stakeholder Workshop (Workshop 2), both workshops provided valuable feedback from stakeholders. Also, both workshops will inform how CDOT updates the protocol and establishes benchmarks in future years. For example, CDOT will be adding precast concrete materials to the protocol in the summer of 2023, and discussions initiated during the workshops have helped guide the development of rules for precast products.

1. Benchmark limits

The next phase of the CDOT EPD program will involve establishment of benchmark limits for the key construction materials, which must be established by January 1, 2025. According to ISO, benchmarking is defined as the “process of collecting, analyzing and relating performance data of comparable buildings or other types of construction works” (ISO 2020). Establishment of benchmarks will be difficult and faces several challenges as stakeholders have different opinions on how the rules should be created. Also, there are limited standards or published literature on the creation of environmental benchmarks for construction materials.

CDOT will be using EPD data collected from contractors on CDOT projects as the basis of benchmark limits. To meet representativeness criteria as defined by industry standards (ISO 2017, Edelen and Ingwersen 2016, Carlisle et al. 2022) the data sources should meet the following:

- Production volume – The data should represent an adequate total volume of the overall market production.
- Geography – A range of geographic locations in Colorado should be represented.
- Temporal data quality – The data should be recent and relevant, and the background data should be in conformance.
- Technology – The data should represent the range of technology types and production methods used in the manufacture of the material.

There are two primary ways to apply benchmark limits in low bid contract delivery, “go/no go” specifications or “incentive/disincentive”. “Go/no go” means that only those products with impacts below the limits can be used by the contractor on the project. “Incentive/disincentive” can take various forms, but in general, impacts can be compared against a benchmark above or below which the material’s impacts can be used to apply pay item penalties or rewards. There are some general recommendations and comments associated with these options.

- Thresholds for go/no go specifications - The basis for setting threshold requirements for purchasing or not purchasing materials in a go/no-go specification needs to be carefully considered. A threshold that is easily or already widely achievable using current practices will not result in improvement, while a threshold that is very difficult with available technology may result in an inability to get responsive bids. (Senseney et al. 2023)
- Incentive/disincentive – It may be a challenge to implement incentive/disincentive limits in the design-bid-build (low-bid) contract delivery system that CDOT uses on most transportation construction projects. The sources of the materials to be used on a construction project are not known until after the winning bidder (contractor) is selected. Also, it will be difficult to determine the timing of incentives. Incentives could be offered at contract award or after award, and either option poses challenges for implementation.

The development and implementation of benchmark limits will require considerable work by CDOT and others. The process needs to be transparent and well researched. Contractors, FHWA, and other state highway agencies around the country will be paying attention to how CDOT implements this important aspect of Buy Clean procurement.

VII. References

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VII. Appendix 1

CDOT (Internal) EPD Workshop
June 8, 2022
CDOT Headquarters, 2829 Howard Place, Denver, CO
East & West Auditorium
Agenda

7:30 – 8:00: Check-in

8:00 – 8:10: Welcome from CDOT Chief Engineer (CDOT - Steve Harelson)

8:10 – 8:25: Opening remarks, history of HB 1303 and other EPD legislation (CU-Boulder - Chris Senseney)

8:25 – 8:45: Overview of LCAs, PCRs, and EPDs (The Right Environment - Joep Meijer)

8:45 – 9:15: Development of CDOT EPD specification and protocol, Q&A (CDOT - Craig Wieden)

9:15 – 9:45: Contractor responsibilities, CDOT project staff responsibilities, entry forms, Pre-con and Pre-pave agendas, Q&A (CDOT - Haley Goodale and RockSol - Bill Schiebel)

9:45 – 10:00: Break

10:00 – 10:10: Help/support system for CDOT project staff (CDOT - Craig Wieden)

10:10 – 10:30: FHWA perspective (FHWA - Brian Dobling)

10:30 – 10:50: Asphalt pavement perspective (CAPA – Tom Peterson)

10:50 – 11:10: Concrete pavement perspective (ACPA – Sarah Sanders)

11:10 – 11:30: Steel perspective from AISC and CSRI (AISC – Max Puchtel)

11:30 – noon: Q&A, open discussion, closing remarks (CU-Boulder - Chris Senseney)

VIII. Appendix 2

CDOT Industry Stakeholder EPD Workshop
August 16, 2022
Folsom Field, 2400 Colorado Ave, Boulder, CO 80305
Byron R. White Club (4th floor)
Agenda

7:30 – 8:00: Check-in, registration

8:00 – 8:10: Opening remarks (CU-Boulder - Chris Senseney)

8:10 – 8:30: Keynote Address, State Representative Tracey Bernett, sponsor of "Buy Clean Colorado Act"

8:30 – 8:50: History of Buy Clean Legislation (CU-Boulder - Chris Senseney)

8:50 – 9:15: Overview of LCAs, PCRs, and EPDs (The Right Environment - Joep Meijer)

9:15 – 9:45: Development of CDOT EPD specification and protocol, Q&A (CDOT - Craig Wieden)

9:45 – 10:15: Contractor responsibilities, CDOT project staff responsibilities, entry forms, Pre-con and Pre-pave agendas, Q&A (CDOT - Hailey Goodale and RockSol - Bill Schiebel)

10:15 – 10:30: Break

10:30 – 10:50: FHWA perspective (FHWA - Brian Dobling)

10:50 – 11:10: Asphalt pavement perspective (CAPA/NAPA – Mike Skinner)

11:10 – 11:30: Concrete pavement perspective (NRMCA – Brian Killingsworth)

11:30 – 11:50: Reinforced steel perspective (CRSI – Rob Kinchler)

Noon – 1:00: Lunch (provided)

1:00 – 1:45: Training

- Administering your First Project with EPD Submission Requirements (Chris Senseney and Bill Schiebel)

1:45 – 2:45: Breakout Sessions

- Discussion: Establishing GHG emission thresholds for materials (in Breakout Rooms)

2:45-3:00: Break

3:00 – 4:00: EPD Panel Discussion (Joep Meijer, Craig Wieden, Brian Dobling; Moderated by Chris Senseney)

4:00 Workshop adjourns