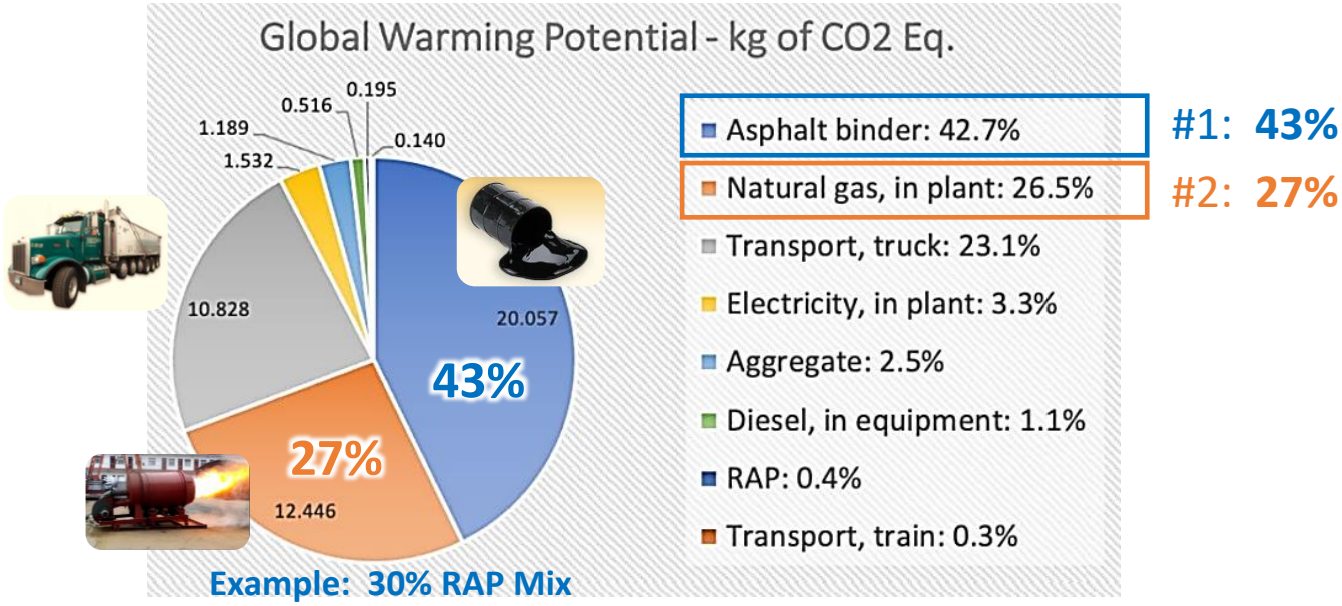
EPD Summary (Feb 21, 2023)

- Several Colorado producers see value in transferring their EPD program from their Environmental Manager to their QC Manager.

- Colorado Office of the State Architect (OSA) also implemented an EPD Program. OSA Policy and GWP Limits will take effect Jan 1, 2024. These will apply to state facilities, including parking lots.

- CDOT began collecting EPD data on July 1, 2022 and their policy and GWP Limits will take effect January 1, 2025.
- The Biden administration on September 15, 2022 announced an updated Federal Buy Clean policy, which directs federal agencies to buy low-emissions asphalt.
- **Sensitivity Factors**
  - **#1 Virgin Binder Content %**
  - **#2 Burner Fuel** (natural gas fuel has lowest EPD).
  - #3 LONG Transport distance (this factor can overwhelm the EPD if VERY long).



- Asphalt Binder EPD. Currently ECO Label uses four national standard inputs (virgin binder, polymer binder, etc.). Asphalt Institute is developing an EPD tool for specific binders/producers. This may/may not have a very significant impact on EPD's and thresholds established.

- Concerns about CO thresholds/limits. How will future methodologies (e.g., BMD, asphalt specific EPD) impact EPDs? In response, CDOT will be creating subcategories for new technologies.

- CDPHE wants producers to wash aggregates (reduce air particulates). Some producers require the dust as part of their mix design. The increased moisture content in the aggregate requires more energy to dry and is larger than the initial dust impact. Example of CDPHE vs CDOT and competing goals.

- **Rules of Thumb**

1% aggregate moisture ≈ 50^{o} drum temp. ≈ 0.5% AC binder ≈ 3 kg GWP

Eliminate/reduce the use of hydrated lime can drop EPD up to 25%

(Solterra Materials in PHX has demonstrated this with lime/liquid antistrip combination)

Concrete Industry: ≈ 85% of the EPD for PCC mixes is attributed to % cement in mixture.

Asphalt Industry: ≈ 70% -80% of EPD is attributed to % binder + burner fuel

FHWA Climate Challenge

- On Earth Day 2022 FHWA released their "Climate Challenge"

"This challenge will quantify GHG emissions from construction pavement materials by encouraging the use of sustainable pavement practices and encouraging quantification of the impacts of those practices."

"State DOTs explore the use of EPDs 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."

- Pilot projects – up to $500k per participant (State DOT)

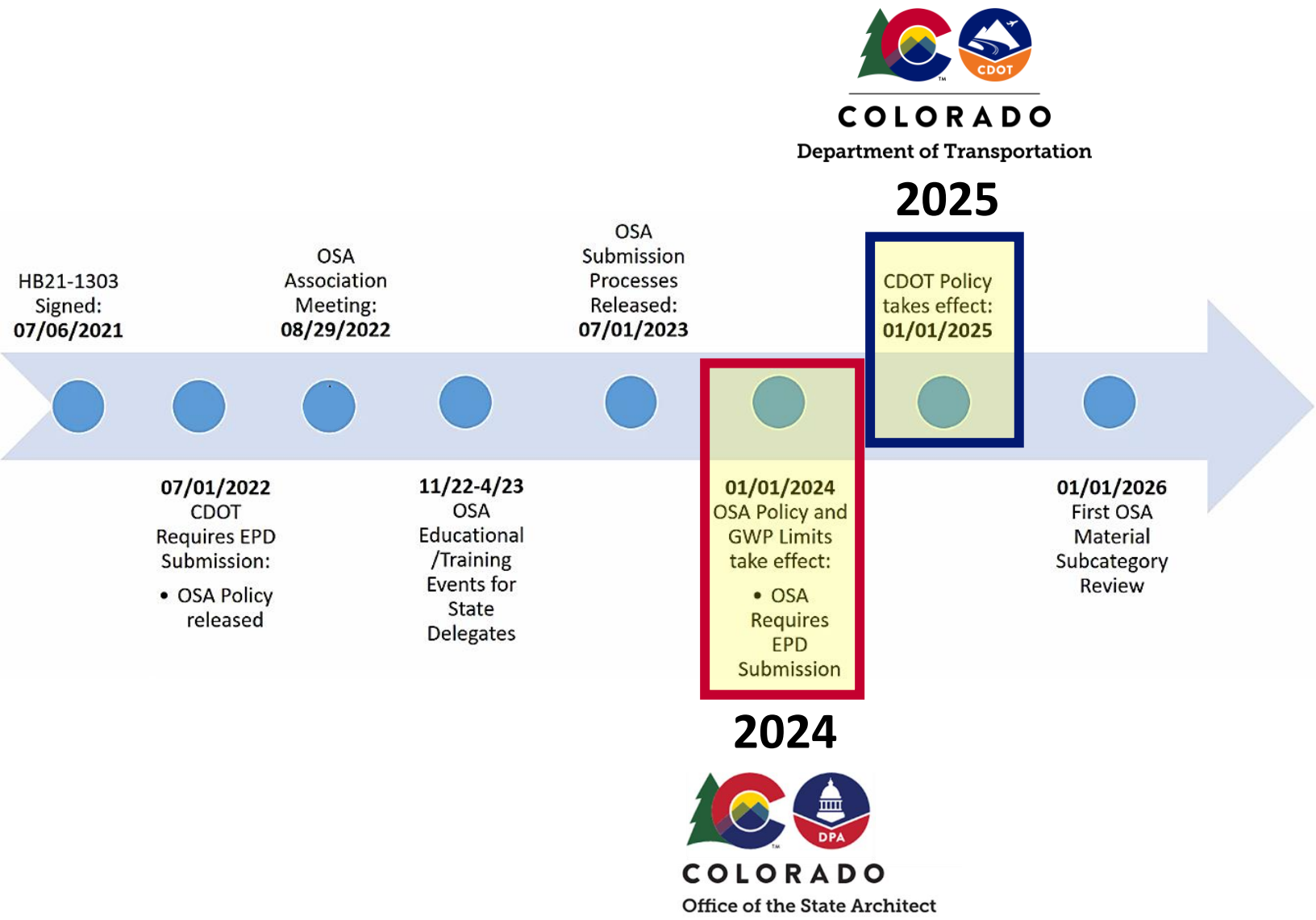
National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Colorado Asphalt Pavement Association

EPD ENVIRONMENTAL PRODUCT DECLARATION

Statewide EPD Implementation

CDOT projects and State Facility Projects



Federal "Buy Clean" Implementation

DOT projects and Federal Facility Projects

The Biden administration on September 15, 2022 announced an updated Buy Clean policy, which directs federal agencies to buy low-emissions steel, concrete, asphalt, and flat glass. The policy is a major step toward decarbonizing the U.S. industrial sector and reducing emissions.

The purpose of Federal Buy Clean Initiative is to spur the development of low-carbon construction materials by leveraging the Federal government's purchasing power to buy cleaner materials, create a market differentiation for low-carbon construction materials, and provide incentives for lower-carbon materials.

Key Actions under September 15th announcement as follows:

- The Federal government *will prioritize* the purchase of low carbon steel, concrete, asphalt, and flat glass construction materials.
- The Buy Clean Task Force will provide instructions to agencies for integrating Buy Clean into federal procurement and funding process. Ultimately, this means public works projects will have to consider carbon emission impacts generated in the manufacturing of these materials.
- The Federal Buy Clean policy will cover federal-funded projects (e.g., Federal-aid Highway funded projects.) The role of state DOTs will be critical.
- In October, the White House will convene States to share knowledge and build capacity for public construction projects that lower carbon emissions.
- The Administration will expand the reliability, transparency, and verification of Environmental Product Declarations (EPDs).
- The Administration will launch Federal Buy Clean Initiative pilots across the country to accelerate innovations and develop a commercial path for a range of low carbon construction materials.
- The Federal Buy Clean Task membership will expand from nine to seventeen members to include the Departments of Commerce, Homeland Security, Housing and Urban Development, Health and Human Services, NASA, and Veterans. They will join Agriculture, Defense, Energy, Transportation, Council on Environmental Quality, Environmental Protection Agency, the General Services Administration, and the Office of Management and Budget.

The U.S. Department of Transportation also announced on September 15th the following actions:

- Explore the use and expansion of Environmental Product Declarations (EPDs);
- Develop a Buy Clean policy based on EPD's that could:
    a. Require EPDs;
    b. Establish a carbon intensity ceiling;
    c. Award performance-based bonuses to high performers

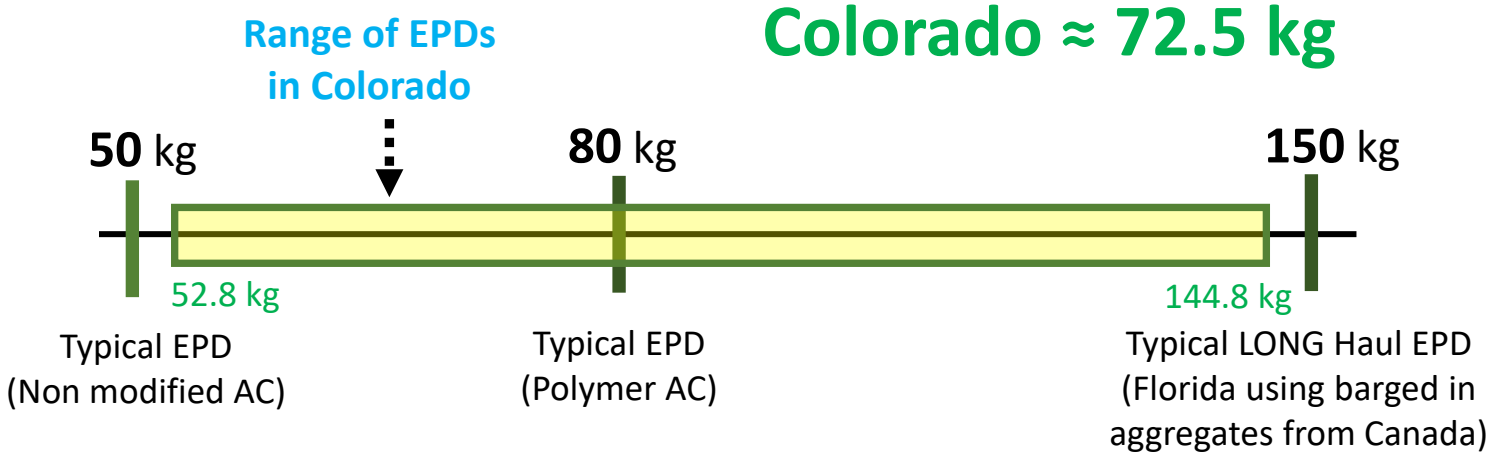
Emerald ECO LABEL

Colorado Asphalt Pavement Association

EPD ENVIRONMENTAL PRODUCT DECLARATION

CO_2 Equiv. (Global Warming Potential)

Colorado ≈ 72.5 kg



Company	Plant	Mix	EPD
Brannan	Lipan	40053-22-L	**71.23**
Brannan	Lipan	40054-22-L	**69.26**
Brannan	Lipan	40211-22-L-J-WMA	**72.82**
Brannan	Rock Creek	40013-22-R	**70.41**
Brannan	Rock Creek	40053-22-R	**71.16**
CASI	CASI Plant	CASI #13	**63.67**
CASI	CASI Plant	CASI #69	**53.96**
Elam	Roland	12-921 5/8” PG64-22	**52.84**
Elam	Roland	12-922 5/8” PG64-22 w/lime	**61.70**

Company	Plant	Mix	EPD
Elam	Silverthorne	12-901 5/8” PG58-28	**58.78**
Elam	Silverthorne	12-901 SX(75) PG58-34 Lime	**72.65**
Four Corners	Animas Glacier	CDOT ST 75	**79.31**
Four Corners	Animas Glacier	CDOT SX 75	**76.70**
Holcim-US	Dahlia ASP	800071-SX-75-V	**79.10**
Holcim-US	Dahlia ASP	80074-SX-75	**73.22**
Holcim-US	Dahlia ASP	80075-SX-100-V	**78.46**
Holcim-US	Dahlia ASP	80078-S-100-25	**67.99**
Holcim-US	Dahlia ASP	80079-SX-100	**71.32**
Holcim-US	Dahlia ASP	800081-S-75	**70.62**
Holcim-US	Dahlia ASP	80082-SX-100-P	**77.09**
Holcim-US	Dahlia ASP	80084-S-100	**70.62**
Holcim-US	Dahlia ASP	801240-SG-100	**67.40**
Holcim-US	Dahlia ASP	801493-SX-75	**72.97**

Company	Plant	Mix	EPD
Holcim-US	Dahlia ASP	801501-S-75	**70.39**
Holcim-US	Longmont ASP	80074-SX-75	**71.65**
Holcim-US	Longmont ASP	80079-SX-100	**69.09**
Holcim-US	Longmont ASP	800081-S-75	**68.45**
Holcim-US	Longmont ASP	800084-S-100	**66.60**
Holcim-US	Longmont ASP	802350-SX-100-P	**76.28**
Kiewit	Aurora	1202-AL-22	**82.29**
Kiewit	Aurora	1202-AL-22-EVO	**83.48**
Kiewit	Aurora	1204-SMA-21	**85.40**
Kiewit	Aurora	1222-AH-21	**77.35**
Kiewit	Aurora	1222-AH-21-EVO	**72.62**
Kiewit	Aurora	1223-AL-22	**72.36**
Kiewit	Aurora	1223-AL-22-EVO	**73.55**
Kiewit	Aurora	1922-AH-RBL-21	**73.26**

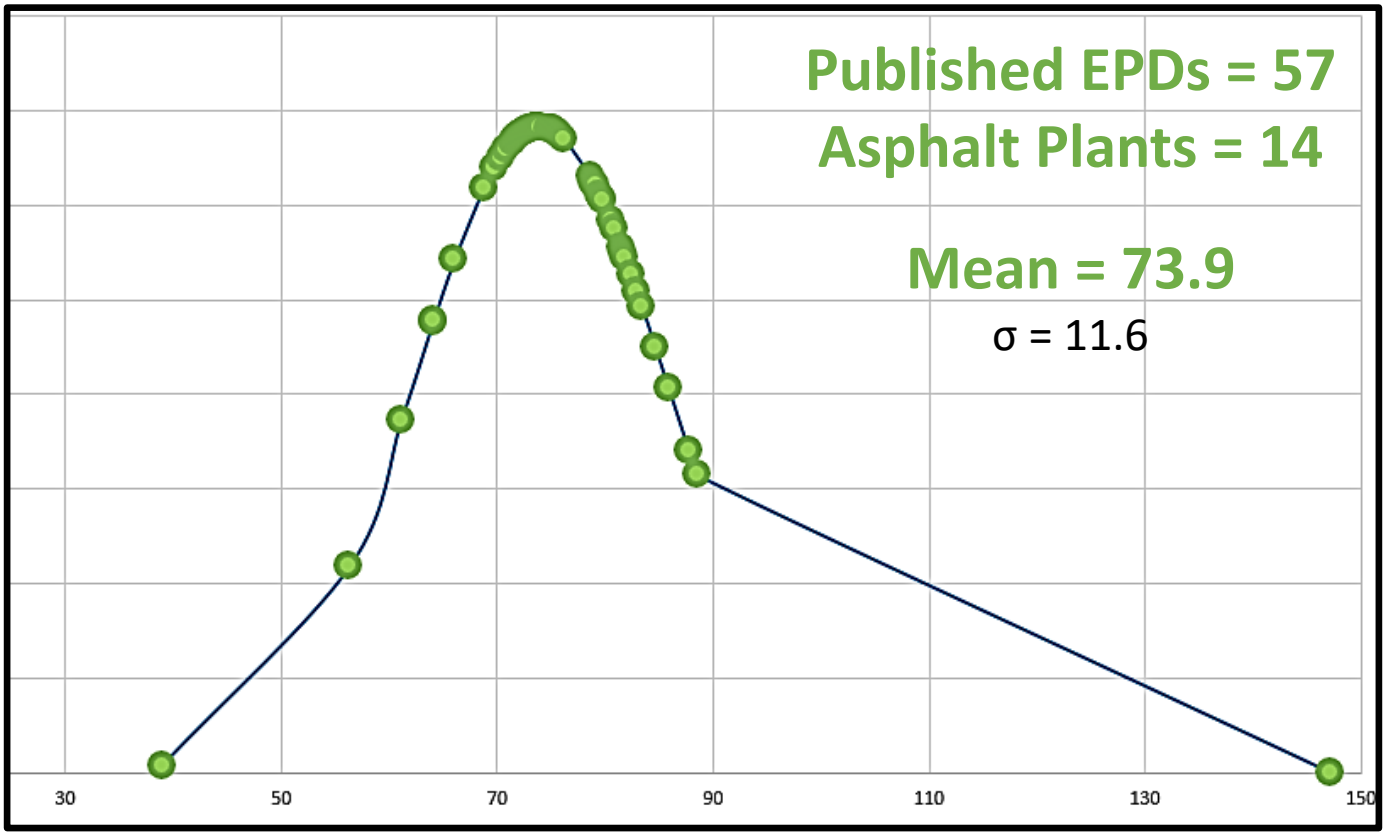
Emerald ECO LABEL

Colorado Asphalt Pavement Association

EPD ENVIRONMENTAL PRODUCT DECLARATION

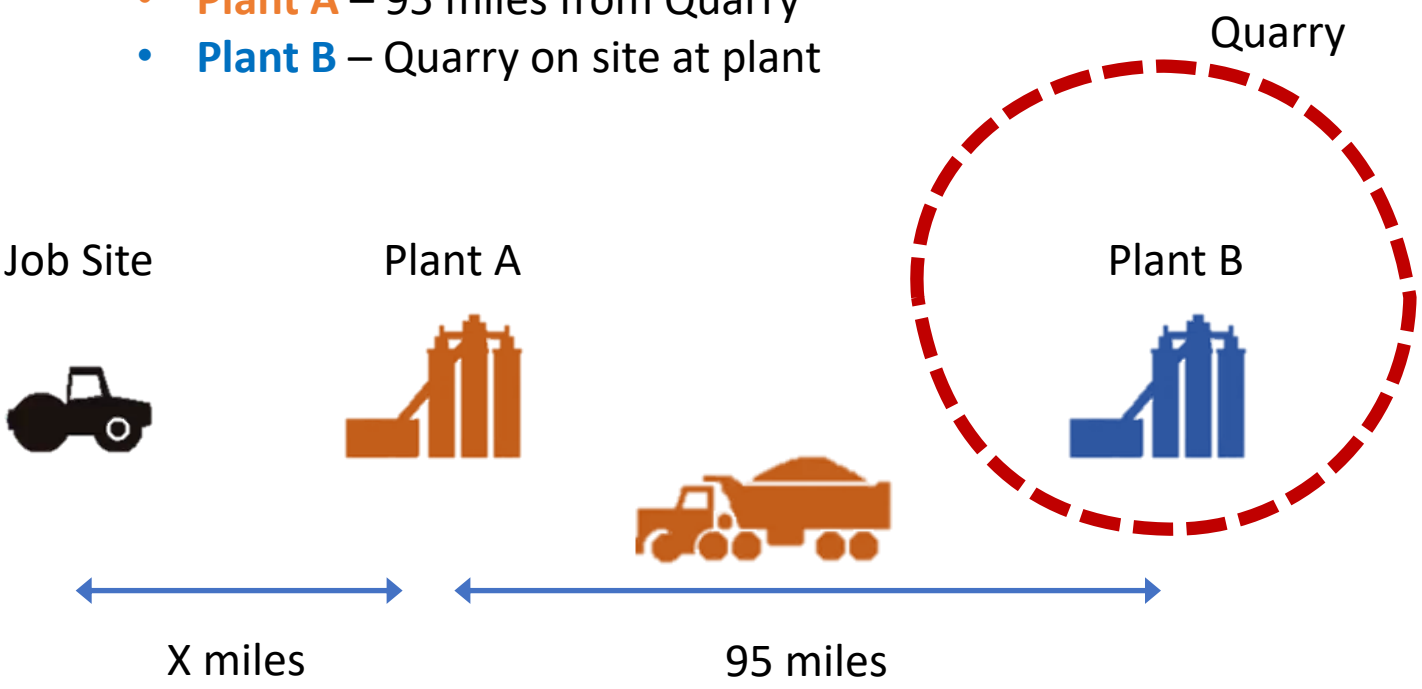
Company	Plant	Mix	EPD
Kiewit	Aurora	1922-AH-RBL-21-EVO	**73.86**
Kiewit	Aurora	1922-AH21	**69.62**
Kiewit	Aurora	1922-AH21-EVO	**69.93**
Kiewit	Colo Spgs	1220-CL-21	**81.06**
Kiewit	Colo Spgs	1224-CH-21	**77.34**
Oldcastle SW Group APC	APC Ralston Gencor Plant	½" SMA(100)PG 76-28	**144.78**
Oldcastle SW Group APC	APC Ralston Gencor Plant	S(100) PG 64-22	**69.97**
Schmidt	Castle Rock	CR ½" 58-28	**80.55**
Schmidt	Castle Rock	CR ½" 64-22	**80.01**
Schmidt	Castle Rock	CR ½" 64-28	**86.15**
Schmidt	Castle Rock	CR ¾" 58-28	**78.17**
Schmidt	Castle Rock	CR ¾" 64-22	**79.45**
Schmidt	Delta	½" 58-28	**71.27**
Schmidt	Delta	½" 64-22	**72.55**

Company	Plant	Mix	EPD
Schmidt	Delta	½” 64-28	**76.65**
Schmidt	Delta	¾” 58-28	**70.76**
Schmidt	Delta	¾” 64-22	**71.40**
United	River Road	SX(100) PG64-22 L Suncor	**77.57**
United	River Road	SX (100) PG76-28 L Suncor	**78.25**
United	River Road	SX(75) PG64-22 Suncor	**62.79**



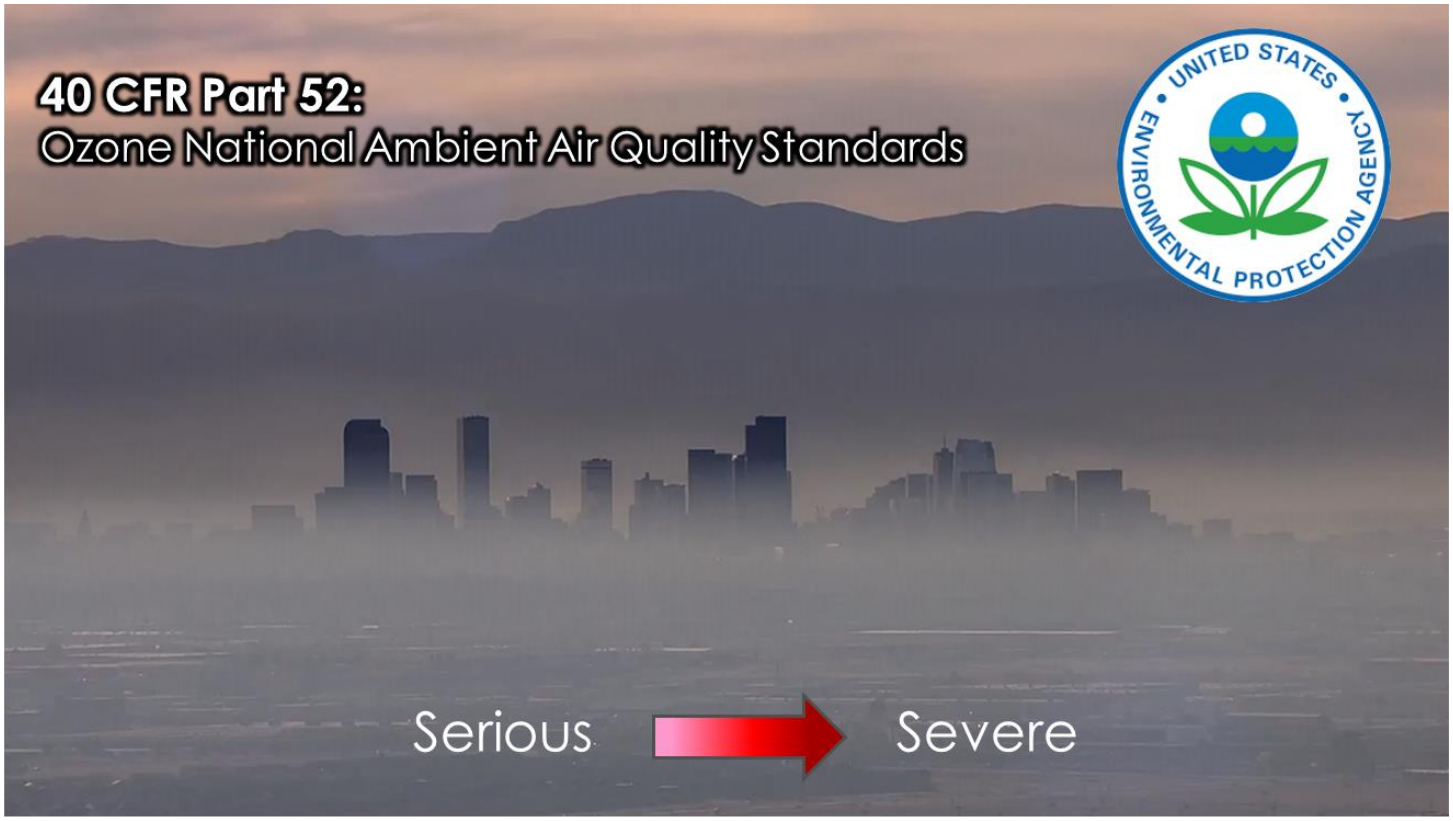
Transport Distance Effect on EPDs

- 2 Identical plants (energy efficiency, fuels, etc.)
- Identical Asphalt Mixes
  - 94% Aggregates
  - 4% binder
  - 1% hydrated lime
  - Source from the same quarry
- **Plant A** – 95 miles from Quarry
- **Plant B** – Quarry on site at plant



Plant A GWP = 82 kg CO2e/ton

Plant B GWP = 69 kg CO2e/ton



Designated area	Classification	
	Date [1]	Type
Denver-Boulder-Greeley-Ft. Collins-Loveland, CO: [2]	November 7, 2022	Severe.

COLORADO
Department of Transportation

Office of the Chief Engineer
Materials and Geotechnical Services Branch

CONSTRUCTION BULLETIN

Environmental Product Declarations (EPDs)
2022 Number 3, Page 1 of 2
Date: August 5, 2022

Environmental Product Declarations (EPDs)

On Tuesday, July 6, 2021, Gov. Jared Polis signed HB 21-1303 Global Warming Potential For Public Project Materials, requiring Contractors to submit Environmental Product Declarations (EPDs) for all eligible materials to include asphalt and asphalt mixtures, cement and concrete mixtures, and steel.

The Standard Special Provision, Revision of Section 101 and 106 - Environmental Product Declarations, outlines the contract requirements for projects bid on or after July 1, 2022.

The protocol document, Appendix O - Environmental Product Declarations of the 2023 Field Materials Manual, provides guidance for the implementation and submission of EPDs. This document also contains cost and small quantity thresholds as well as the specific bid items requiring EPDs.

The CDOT EPD team is working with OIT on a more permanent EPD submission and storage solution through OnBase. In the meantime, EPDs shall be submitted using this Google Form.

The construction conference agendas have been updated to include items for the collection and submission of EPDs. The updated versions are linked below:

- Preconstruction Conference Agenda
  - Landscape orientation
  - Portrait orientation
- Pre-paving Conference Agenda
  - Asphalt
  - Concrete

The CDOT EPD team requests invitations to the Preconstruction and Pre-pave meetings for all eligible projects with an Engineer's Estimate of $3,000,000 or greater (not including CE, Indirect, or Force Account costs). Those invitations can be sent to the CDOT EPD email address.

A tool has been developed to assist project staff and Contractors in determining when EPDs are required for eligible materials. That spreadsheet can be accessed here.

OSA August and December 2022 Webinar's Highlights:

- Opening remark from Bailey was that "this is work that they (OSA) are doing". Bailey is an Engineer in Training and a recent graduate of CU Boulder.
- OSA is establishing GWP limits for eligible materials while CDOT is developing the process to record emission reductions that result.
- OSA is developing an EPD compliance form, where questions are answered, and instant feedback is provided as to weather or not the EPD is considered acceptable. Published NAPA EPDs in Colorado so far are Type III EPDs that reference ISO 14025:2006 and ISO 21930:2017 but do not reference ISO 14040:2006 and ISO 14044:2006 meaning they are not in compliance with the OSA. **Will need to clarify this with NAPA/OSA**
- OSA GWP limit "may include transportation-related emissions". If the transportation distance for a material is more than 100 miles, then the OSA will want the weight, transportation method and total distance. The OSA will collect this information for now but will not consider it a criteria yet. This transportation is already included in the NAPA tool. **Will need to clarify this with NAPA/OSA.**
- Starting 1/1/2024 – Design consultants shall prioritize materials that have EPDs for the design of buildings, cost estimates shall be built using eligible materials with EPDs, and EPD submittals for materials will be required prior to installation of those materials.
- OSA believes that following this bill will result in buildings with lower embodied carbon emissions.
- Senate Bill 22-51 will provide tax exemptions on eligible materials
- Firms and contractors will be selected based upon their ability to meet these requirements.
- OSA will set limits in 2023 for each subcategory and types within each subcategory based upon industry wide GWP data.

Balance Engineering's tea leaf reading & recommendations:

- The OSA views this as work that they are doing – they are forcing contractors/producers to change their manufacturing processes to meet the maximum GWP requirements that they will set fourth starting in 2023. The only response to this stance is to state that the asphalt production processes are largely controlled by the construction specifications of the agency that oversees the project.
- CDOT's standard revision for CDOT projects requires 1% hydrated lime by weight of aggregate, aggregate moisture 2% above the SSD condition of the aggregate, minimum and maximum mix discharge temperatures, minimum delivered mix temperatures, and maximum rap percentage. These specifications greatly restrict the ability of contractor/producer to change their manufacturing processes to lower a GWP number.
- The MGPEC specifications will allow for industry to make mixes with a lower EPD right now. Industry knows this, but industry will need to prove this. Industry will need to track what the EPD is for mixes with hydrated lime and it's requirements and track what the EPD is for mixes without hydrated lime and it's requirements.
- Industry & Agency will both need to get a comfort level with new mixes that are designed per MGPEC criteria. Specific mixes for OSA will be MGPEC mixes: Grading ST for leveling, maintenance, bike paths, and sidewalks, Grading SX for top and bottom lifts, and patching, Grading S for lower lifts only. These gradings and uses are all per MGPEC item 20, 2022 specifications.
    - MGPEC mixes allow for 30% RAP.
    - WMA is allowed so long as it is included on CDOT's APL, but also WMA technology is allowed for use as a compaction aide. Using WMA allows for the mix discharge temperatures to be lowered at the discretion of the contractor so long as all specifications are achieved
    - Anti-Strip is required, but it can be liquid anti-strip. (WMA)
    - The Lottman test is per AASHTO T 283, which is 70-80% saturation subject to a freeze/thaw cycle.
    - Production mix tolerances is by AC Content and Gradation with additional testing as required by the agency.

Highlights from GHG Emissions Inventory Report from NAPA (Dec. 2022)

- Nationwide, increasing the use of RAP by 1% would result in 0.14 million metric tonnes (MMT) in avoided GHG emissions. Which is equivalent to the annual emissions from approximately 30,000 passenger vehicles.
- In 2019, the use of RAP avoided 2.4 MMT of GHG emissions and yielded $3.3 billion in economic savings.
- It was estimated in 2019, that the production of asphalt at reduced temperatures avoided GHG emissions of 0.05 – 0.21 MMT.
- In 2019, Cradle-to-gate GHG emissions for asphalt mix production in the USA were approximately 21.7 MMT. This is 0.3% of the total U.S. GHG emissions inventory and 1.3% of the total industrial emissions. No single industry represents more than a few percent of total industrial emissions.
- In 2019, approximately 28% of U.S. emissions came from transportation emissions from Fossil Fuel Combustion and approximately 23% of U.S. emissions came from highway transportation emissions from Fossil Fuel Combustion. Industrial emissions accounted for approximately 25%.
- Vehicle emissions are 10 to 400 times greater than emissions associated with materials, construction and maintenance of the roads they travel on.
- Technologies that asphalt industry can use to lower emissions are: RAP, choice of fuel, reduce moisture in aggregate stockpiles, reduce burner fuel consumption, WMA technologies and electrical capital improvements.
- 2018 U.S. EPA report declares a typical vehicle emits 4.6 tonne CO2 per year.
- At a nominal aggregate moisture content of 5%, evaporation accounts for more than 40% of burner fuel consumption.
- A policy barrier to increased use of RAP is the practice by a few agencies of retaining ownership of RAP instead of transferring ownership to the paving contractor.
- Policies that allow paving contractors to retain ownership and recycle RAP into new asphalt mixtures would yield net GHG emission reductions due to reduced upstream emissions from avoided use of virgin asphalt binder.
- A primary source of GHG emissions during asphalt production is burner fuel consumption for the heating and drying of aggregates.
- A practical limit to the reductions in fuel consumption using WMA technologies is the need to completely dry the aggregates to ensure proper coating and adhesion of the asphalt binder to the aggregates.

Balanced Engineering Notes & Calculations from the data in the report:

In 2019, asphalt mix production accounted for 21.7 MMT of emissions. The population of the US is 332 million. If 160 million people have a typical vehicle emitting 4.6 tonnes of emissions per year, this comes to 736 MMT of emissions. **Asphalt mix production in 2019 is less than 3% of 160 million people having a typical vehicle emitting 4.6 tonnes of emissions.**

NAPA Update (1.25.2023)

Emerald Eco-Label Updates

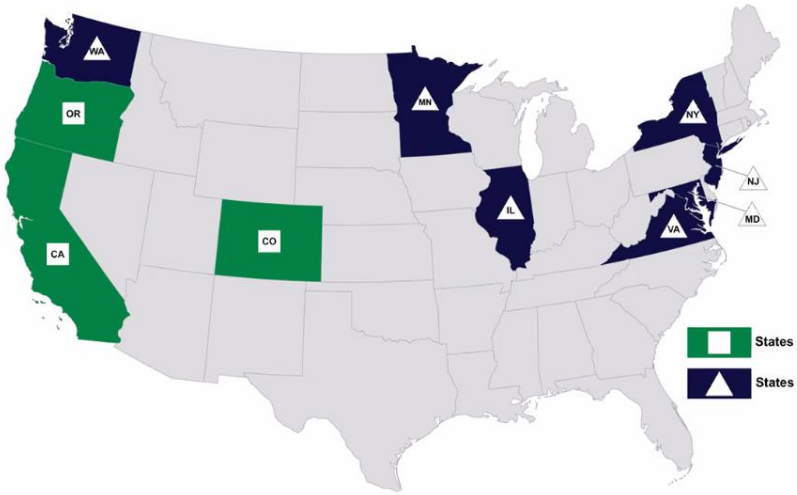
Published EPDs

- >400 mixes
- 70 plants
- 25 States

Software Updates

- Working on contract to add portable plants and other functionality
- Portable plants expected to come online by April 1
- Other functionality expected in Q2 2023

Buy Clean Policies at the State Level



Information collected from State legislative websites.

States that legislated green public purchasing

States that have considered green public purchasing legislation in past 2 years

EPA EPD Program was included in Inflation Reduction Act **(2022)**

Draft EPD Values for GSA projects **(January 2023)**

Inflation Reduction Act

EPA Interim Determination of Substantially Lower Embodied Carbon

- **Best performing 20%** of similar materials/products
  - If not available locally, then **best performing 40%**
  - If not available locally, then better than **estimated industry average**
  - **Agencies will define these thresholds** based on published EPDs
- Also, report **ENERGY STAR** Energy Performance Score (currently under development for asphalt plants)

https://www.epa.gov/inflation-reduction-act/inflation-reduction-act-programs-fight-climate-change-reducing-embodied

GSA DRAFT Low Carbon Material Standard

- Federal office buildings, courthouses, and land ports of entry

GSA IRA Limits for Low Embodied Carbon Asphal **Jan. 2023**

(Uncertainty-Adjusted GWPs, in kilograms of carbon dioxide equ[illegible] per metric ton - $kgCO_2e/t$)

Top 20% Limit	Top 40% Limit	Average or Better Limit
62.8	74.0	85.0

- "Uncertainty adjustment" is arbitrarily assigned
- Same limits apply to all mix types

DRAFT

FHWA Pushing EPD's for
Transportation Planning & Project Delivery
(2023-2024)

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BALANCED ENGINEERING

Colorado Asphalt Pavement Association
6880 S Yosemite Ct
Centennial, CO 80112

February 22, 2023

Subject: EPD General Information and Specific Information for SMA EPDs

"EPD number" is slang for Total Global Warming Potential (GWP) 100. Total GWP 100 is the sum of materials (A1), transport (A2), and production (A3). The aggregate portion of Materials (A1) is derived from national data and is calculated in the NAPA software. The binder portion is much higher when a modified binder is used in comparison to an unmodified binder. Transport (A2) is specific to the transport of the individual materials comprising the mix design. Production (A3) is specific to the energy use and tonnage produced at the specific facility over one year regardless of the mixes produced.

A total of 5 different states have published EPDs for SMA. The table below summarizes the data

State	Mineral Filler?	RAP?	Hydrated Lime?	Polymer Modified Binder?	Materials (A1)	Transport (A2)	Production (A3)	Total GWP (Sum of A1-A3)
PA	Yes	No	No	Yes	166.62	5.77	28.24	200.62
MD	Yes	Yes	No	Yes	48.00	5.75	23.07	76.82
NJ	Yes	No	No	Yes	159.67	9.13	19.34	188.14
AR	Yes	No	No	No	146.12	12.82	23.76	182.70
CO	Yes	No	Yes	Yes	114.75	1.74	28.29	144.78
CO	No	No	Yes	No	56.40	7.39	21.61	85.40

The conclusion from this table is that the EPD number for SMA is almost entirely specification driven. In Colorado it is specified that a mineral filler be used, no RAP is allowed, hydrated lime be used at 1% by weight of aggregate, the aggregate needs to be wetted 2% above SSD condition, and a PG 76-28 (modified binder) be used. Following the current CDOT specification, Materials (A1) is the driving force making the EPD number higher.

If you have any questions on the contents of this letter, please contact us at your convenience.

Sincerely,

Balanced Engineering LLC

Dylan A. Hullinger, P.E.