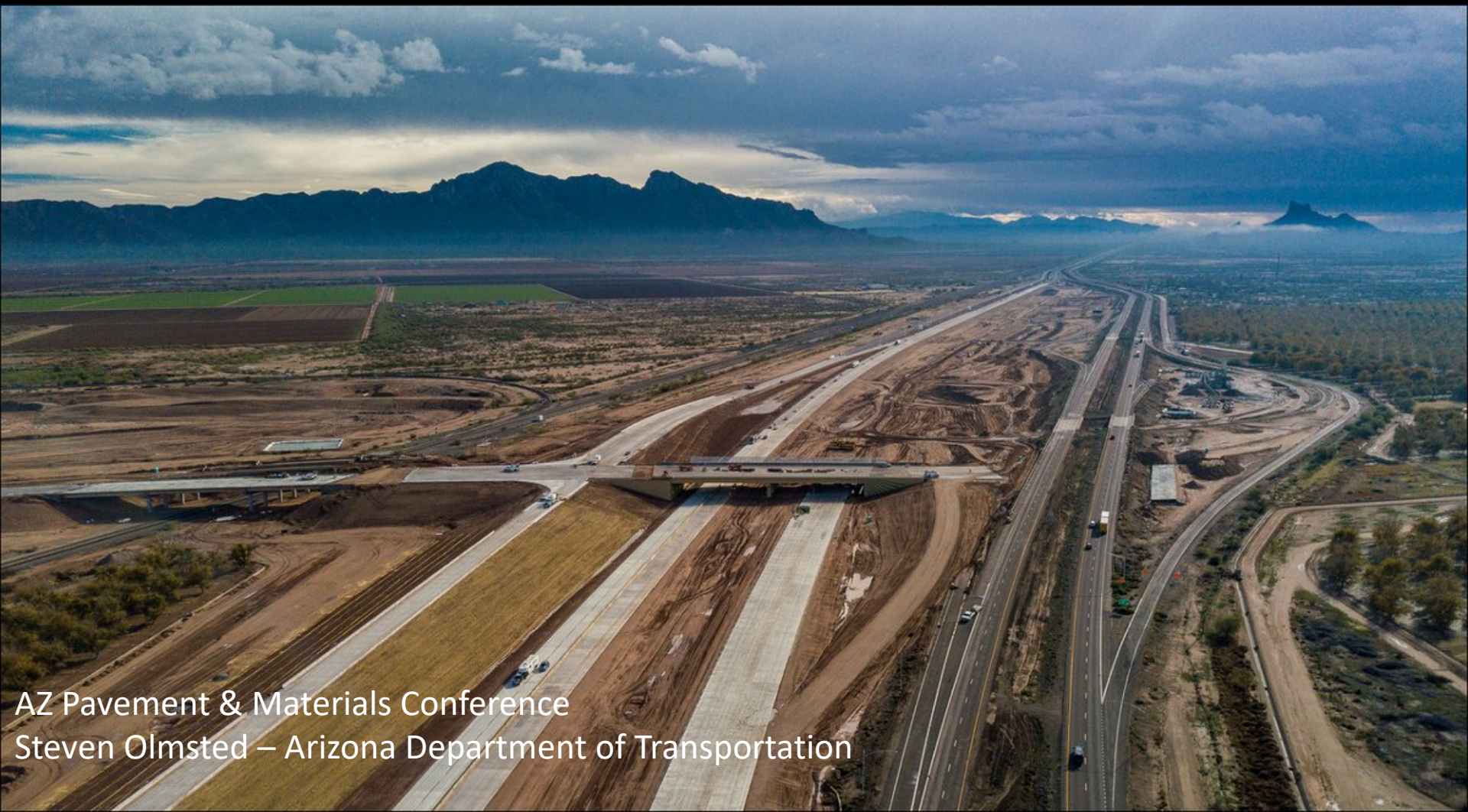
AZ DOT Sustainable Pavement Program Experience with FHWA's Sustainable Pavements Program & What is on the Horizon



AZ Pavement & Materials Conference
Steven Olmsted – Arizona Department of Transportation

Arizona & AZ DOT Assets

Arizona

140,000 Maintenance Lane Miles

8,000 Bridges

1 International Border – 15 POEs

ADOT

30,000 Maintenance Lane Miles

5,000 Bridges

7 Maintenance and Construction Districts

1,500 Facility Buildings

- Spread over 114,000 square miles
- Asset operate from sea level to 8,000 feet
- Temperature below 0°F to over 150°F
- $9.5B 2024-2028 5-Year Transportation Construction Program

Pavement Sustainability Basics

Sustainability is everything you already provide ADOT but furthers how we consider the balance of the environmental, social, and economic needs.

Sustainable Pavement indicate pavement's ability to:

- Achieve the engineering goals for which it was constructed
- Preserve and restore surrounding ecosystems
- Use financial, human, and environmental resources economically
- Meet basic human needs such as health, safety, equity, employment, comfort, and happiness

Sustainable Pavement Defined

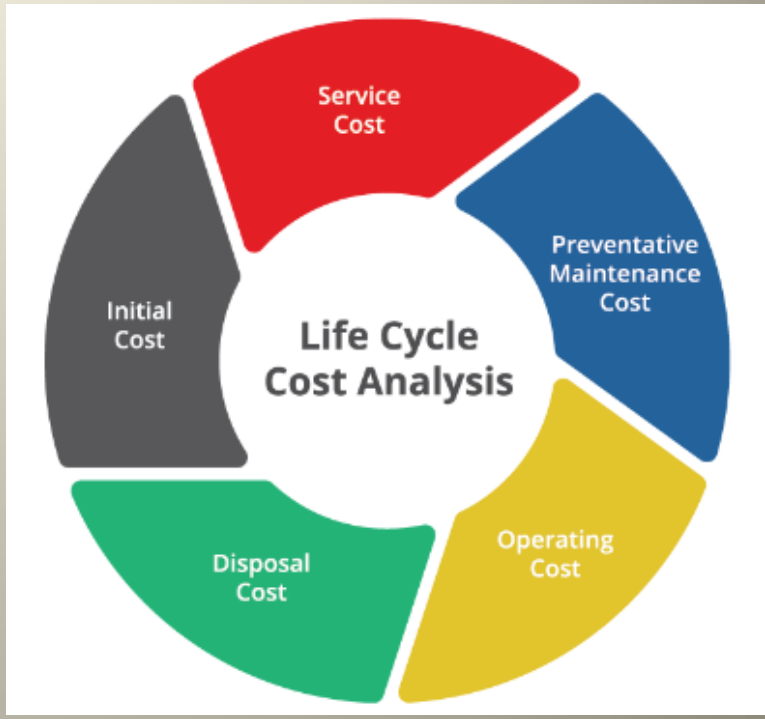
FHWA *TechBrief* on Pavement Sustainability (2014)
http://www.fhwa.dot.gov/pavement/sustainability/hif14012.pdf
FHWA's *Toward Sustainable Pavement Systems* (2015)
http://www.fhwa.dot.gov/pavement/sustainability/hif15002/hif15002.pdf

- FHWA defines a sustainable pavement as one which "achieves its specific engineering goal" (i.e., meeting accepted performance standards) while meeting "basic human needs," using "resources effectively," and preserving/restoring ecosystems
- Pavement sustainability is meant to involve every phase of the pavement life cycle, including **1)** materials production, **2)** pavement design, **3)** construction, **4)** use, **5)** preservation, maintenance, and rehabilitation (the main emphasis of INVEST OM-07), and **6)** end-of life management

Pavement Sustainability Basics

Life-Cycle Cost Analysis (LCCA)

- LCCA is an analysis technique that uses economic analysis to evaluate the total cost of an investment option in constant dollars over an analysis period. As such, it is principally used to address the economic component of sustainability.



- LCCA does not directly address societal or environmental issues (e.g., clean air and water, habitat impacts, establishment of livable community conditions) unless such issues can be monetized.

Pavement Sustainability Basics

Life-Cycle Assessment (LCA)

- LCA is a technique that can be used for analyzing and quantifying the environmental impacts of a product, system, or process. LCA provides a comprehensive approach to evaluating the total environmental burden of a product or process by examining all of the inputs and outputs over the life cycle, from raw material production to end of life. This systematic approach identifies where the most relevant impacts occur and where the most significant improvements can be made while identifying potential trade-offs.

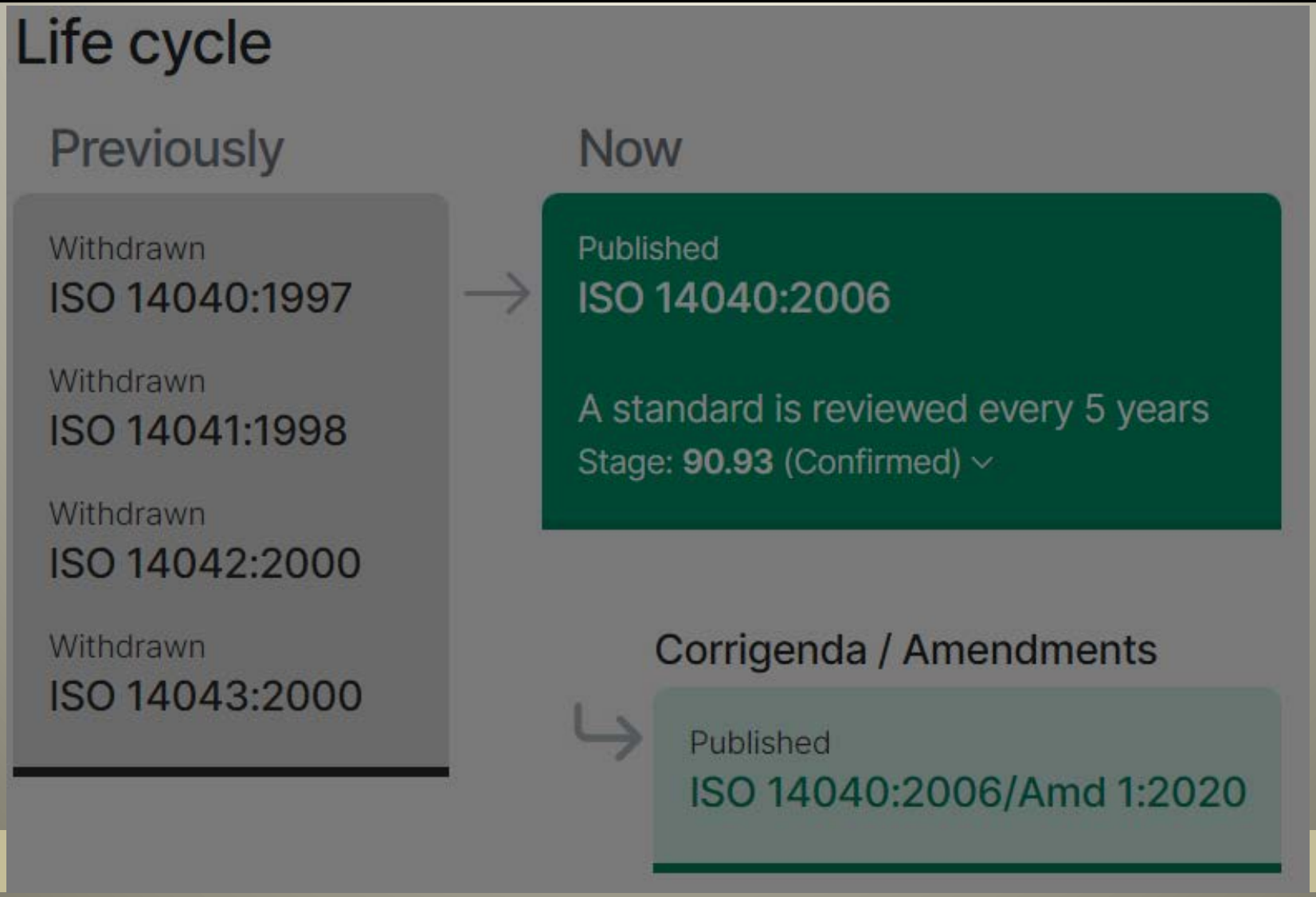
Pavement Sustainability Basics

Life-Cycle Assessment (LCA) continued

- LCA is a field of science that is still evolving, yet it has demonstrated real-world value over the last two decades by helping manufacturers, companies, governments and other groups identify what is environmentally important to them and then to define needed actions to improve their environmental impacts.

- The processes and rules for conducting an LCA are generally defined by the International Organization for Standardization (ISO) in its 14040 family of standards (ISO 2006). These standards are quite broad; thus, more precise guidance is needed for their application to a specific material or process. https://www.iso.org/standard/37456.html

Pavement Sustainability Basics



Pavement Sustainability Basics

What is then the optimum format for conducting pavement sustainability analysis? The associated assessment methods and metrics:

- Economic: LCCA and Life Cycle Planning (LCP)
- Environmental: Life Cycle Assessment (LCA)
- Social: Sustainability Rating Systems (SRS) and Social LCA (SLCA)

Typical LCA impact categories

Group	Impact Categories
Energy use	Fuel: non-renewable, renewable
Resource use	Resources: non-renewable, renewable
Emissions	Climate Change Ozone layer depletion Acidification Tropospheric Ozone Eutrophication
Toxicity	Human toxicity: respiratory, carcinogenic, non-carcinogenic Ecotoxicity: fresh water, marine water, soil
Water	Fresh water use
Waste	Hazardous, Non-hazardous

2017 Arizona DOT Black & Green Sustainable Pavement Systems Program

Arizona DOT Sustainable Transportation Program Linkage

ADOT's pavement management contributes to sustainability by enhancing roadway safety, optimizing pavement life cycles to reduce costs, while considering the environmental impacts of construction and material usage.

ADOT Application Sustainability Matrix

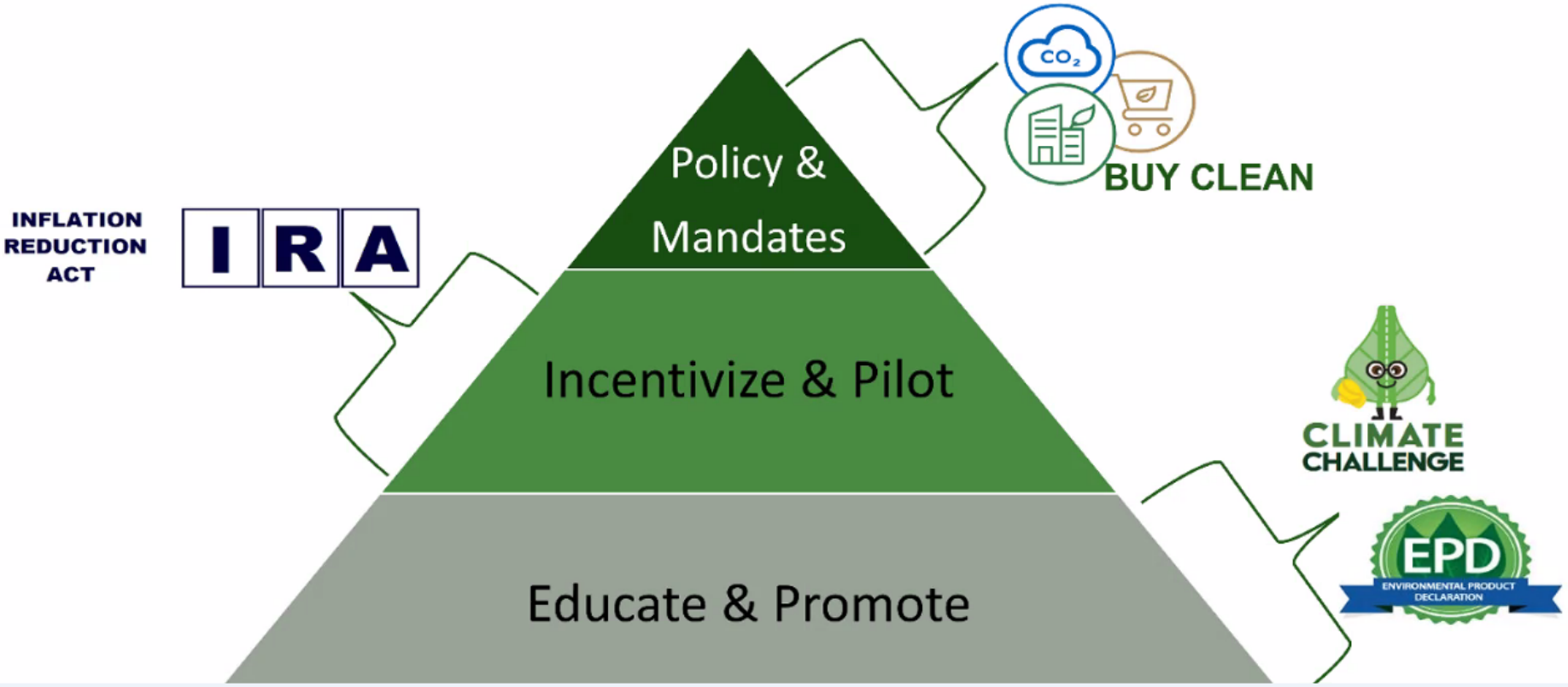
Treatment	Description	Economic	Social	Environmental
Crack Filling	Placement of adhesive material	Life : Low Cost: Low	Aesthetics/Roughness	Low
Crack Sealing	Placement of adhesive material	Life : Low Cost: Low	Aesthetics/Roughness	Low
Asphalt Patching	Localized structural distress	Life : Medium/Low Cost: Medium/Low	Aesthetics/Roughness	Low Variable
Fog/Seal Rejuvenators	Very light asphalt emulsion application	Life: Low Cost: Low	Improved Aesthetics	Medium Variable
Chip Seal	Sprayed application/subsequent chips	Life : Medium/Low Cost: Medium/Low	Improved Friction/Roughness	Medium High
Slurry Seal	Mix of well-graded aggregate/emulsion	Life : Medium/Low Cost: Medium/Low	Aesthetics/Improved Friction	Medium
Microsurfacing	Crushed, well graded aggregate/emulsion/multiple course	Life: Medium/High Cost: Medium	Aesthetics/Improved Friction	Medium Variable
Hot In-Place Recycling	Heat or mechanically loosening within top 2"	Life: Medium/High Cost: Medium/High	Aesthetics/Ride Quality/Friction	Medium High
Cold In-Place Recycling	Milling and sizing reclaimed asphalt pavement (RAP)	Life: Medium/High Cost: Medium	Aesthetics/Ride Quality/Friction	Medium Variable

AZ DOT Sustainable Pavement Program Horizon

- Greenhouse gases (also known as GHGs) are gases in the earth's atmosphere that trap heat
- Carbon dioxide (CO2) makes up the vast majority of greenhouse gas emissions from the sector, but smaller amounts of methane (CH4) and nitrous oxide (N2O) are also emitted
- These gases are released during the combustion of fossil fuels, such as coal, oil, and natural gas, to produce electricity
- Embodied carbon - represents the millions of tons of carbon emissions released during the lifecycle of building materials, including extraction, manufacturing, transport, construction, and disposal

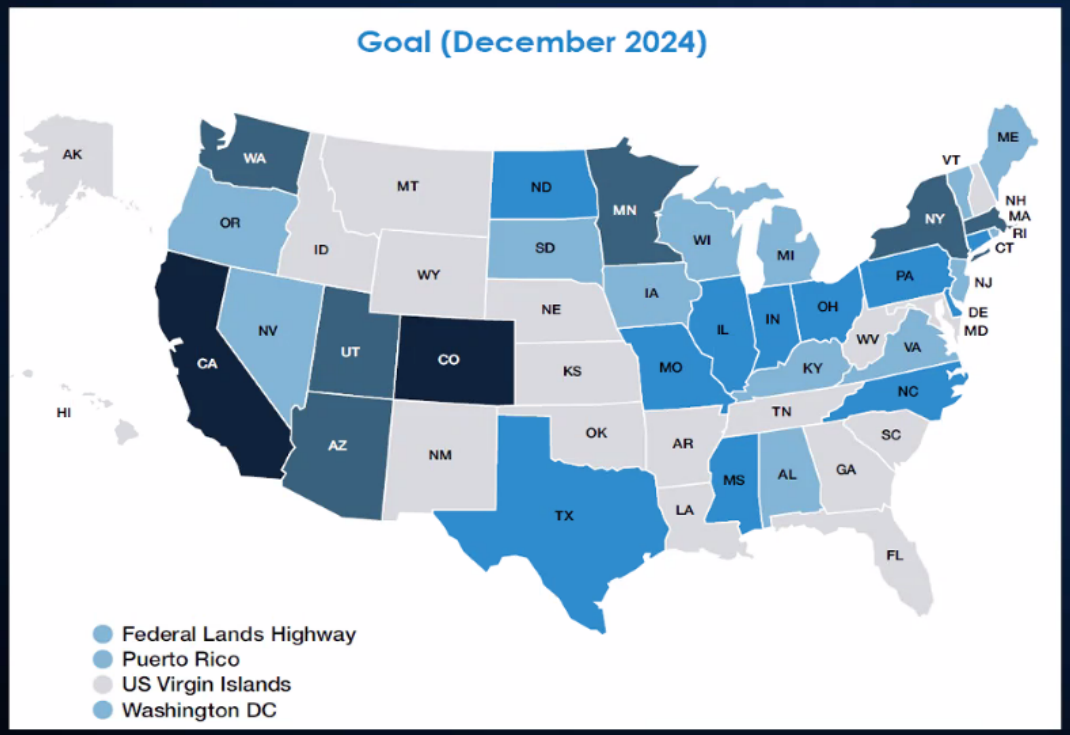
AZ DOT Sustainable Pavement Program Horizon

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



AZ DOT Sustainable Pavement Program Horizon

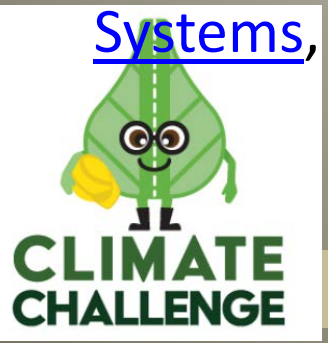
EPDs for Sustainable Project Delivery Participants



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

AZ DOT Sustainable Pavement Program Horizon

- Aligns with and supports activities related but not limited to the Executive Order 14057, *Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability*.
- Directly addresses related concerns from agencies and industry, including data gaps and the need for more implementation assistance.
- Encourages the use of LCAs and EPDs.
- Highlights existing resources from the FHWA Sustainable Pavements program. Examples include the new FHWA LCA Pave Tool and documents such as the Emissions from Highway Transportation Systems, and the Environmental Product Declaration Tech Brief



AZ DOT Sustainable Pavement Program Horizon

Program path and theory of change