



U.S. Department of Transportation
Federal Highway Administration



Sustainability and Resilience of Concrete Pavements

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in this presentation.



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Except for any statutes or regulations cited, the contents of this presentation do not have the force and effect of law and are not meant to bind the public in any way. This presentation is intended only to provide information to the public regarding existing requirements under the law or agency policies.



Acronyms

- EPD Environmental Product Declaration
- GGBFS Ground Granulated Blast Furnace Slag
- LCA Life Cycle Assessment
- LCCA Life Cycle Cost Analysis
- M&R Maintenance and Rehabilitation
- MCTC Mobile Concrete Technology Center
- PCR Product Category Rules
- S-LCA Social Life Cycle Assessment
- SPP Sustainable Pavements Program



Why? Green Public Purchasing Initiatives



Information collected from State legislative websites.



States that legislated green public purchasing



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



Executive Order on Federal Sustainability

EO 14057- Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability [1]



Section 102 (a)(v)

Net-zero emissions from Federal procurement, including a Buy Clean policy to promote use of construction materials with lower embodied emissions.



Section 303

The Buy Clean Task Force provides recommendations to the Chair of the Council on Environmental Quality (CEQ) and the Director of the Office of Management and Budget (OMB) on policies and procedures to expand consideration of embodied emissions and pollutants of construction materials in Federal procurement and federally funded projects.

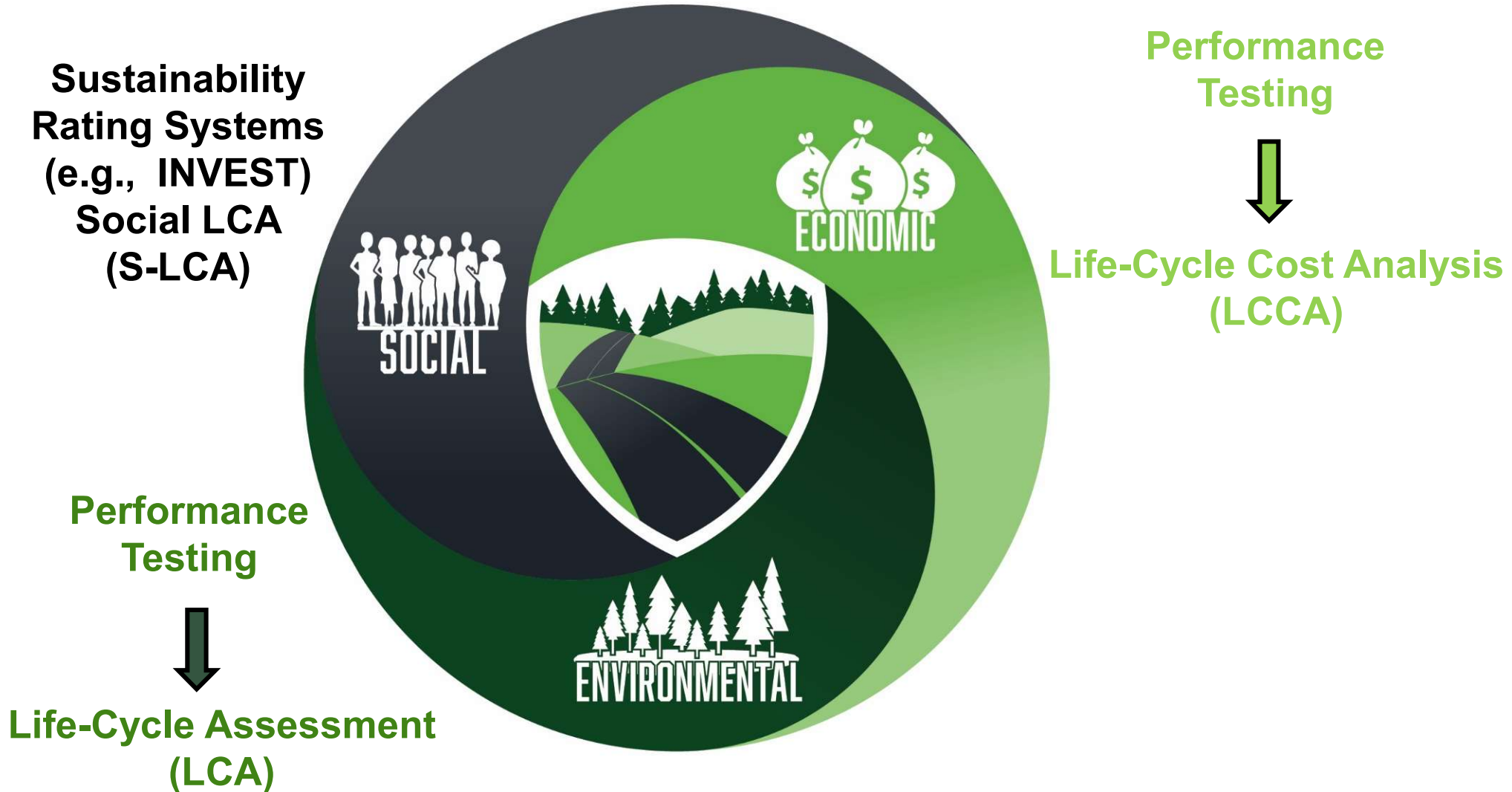


Green Public Procurement (GPP)

- Public procurement is the primary economic activity of government.
 - Used by government for pursuit of strategic objectives.
 - Influences the remainder of the market and private sector.
 - **Basic principles: transparency, integrity, economy, openness, fairness, accountability, competition.**
- GPP is the practice of selecting products with lower environmental impacts than commonly procured products.



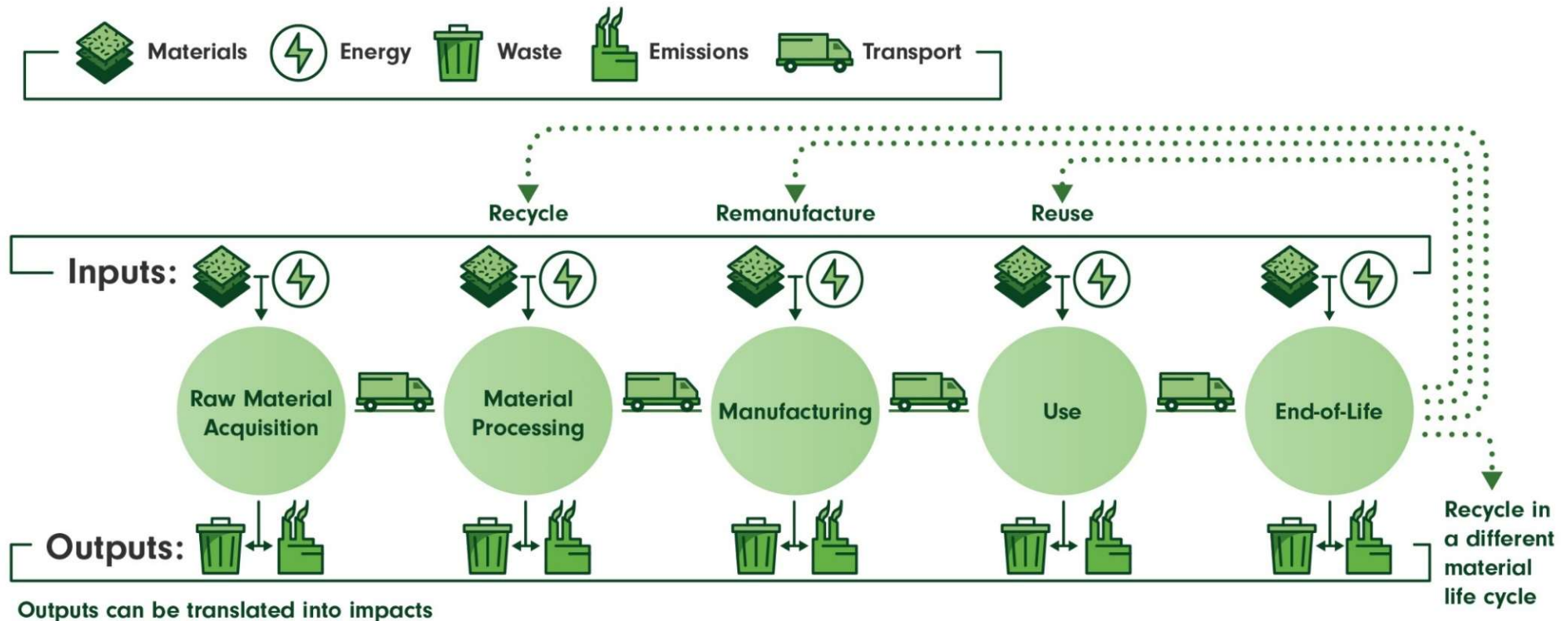
Balance of the Triple Bottom Line





Life Cycle Assessment

- Technique to quantify environmental impacts of products and processes
- Covers range of environmental impacts





EXAMPLE





A Research Study on Paving Concrete

- Collaborative study of SPP and MCTC
- Study objectives:
 - Evaluate the state of practice for paving concrete
 - Identify the opportunities for improvement
 - Identify strategies for pavement agencies to achieve GHG savings for concrete pavements

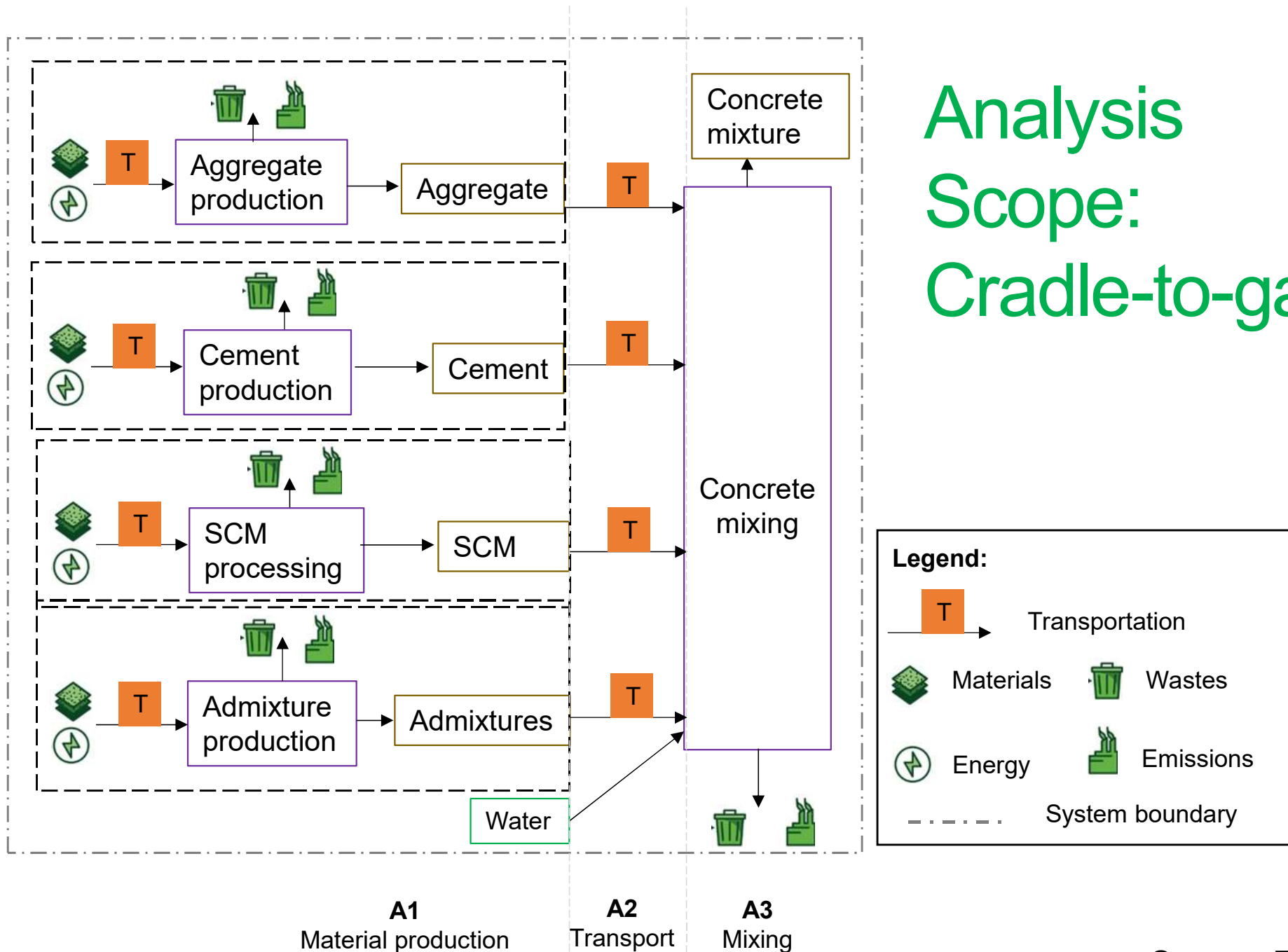


Source: FHWA



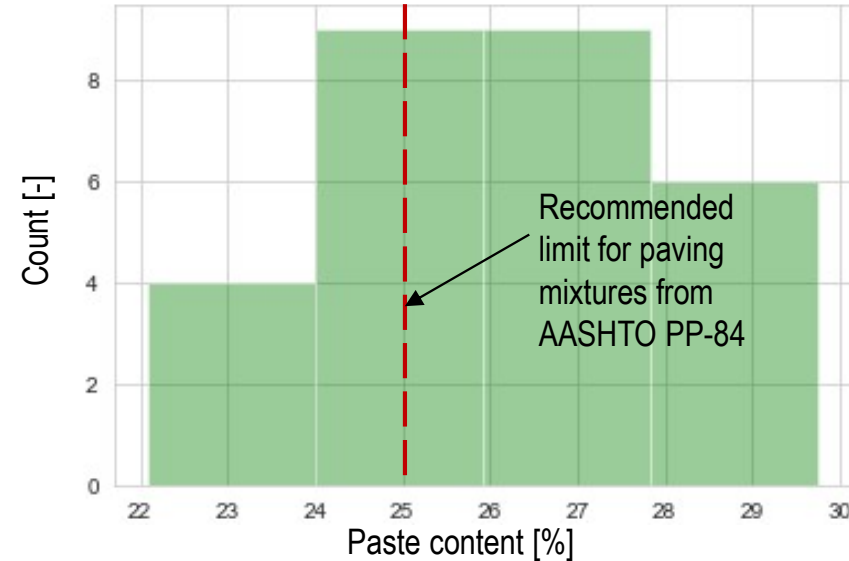
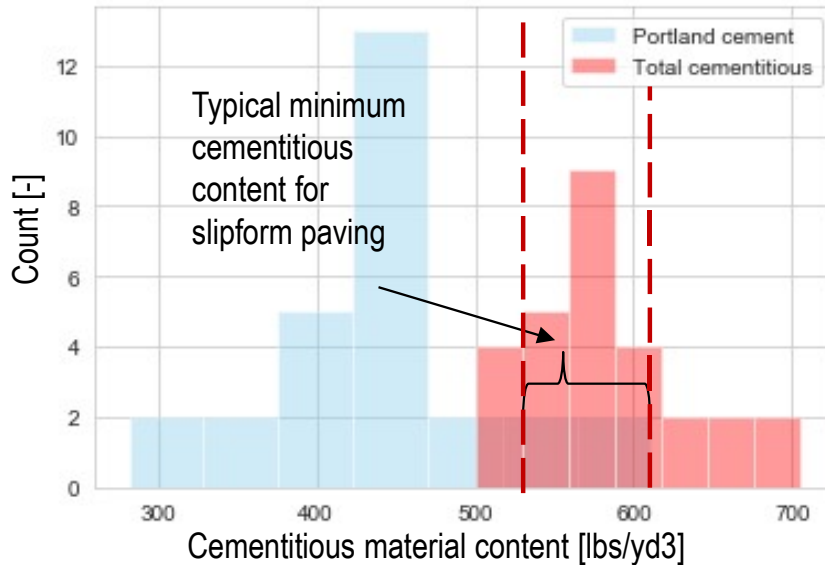
MCTC Concrete Paving Projects (2011-2019)







Mixture Statistics



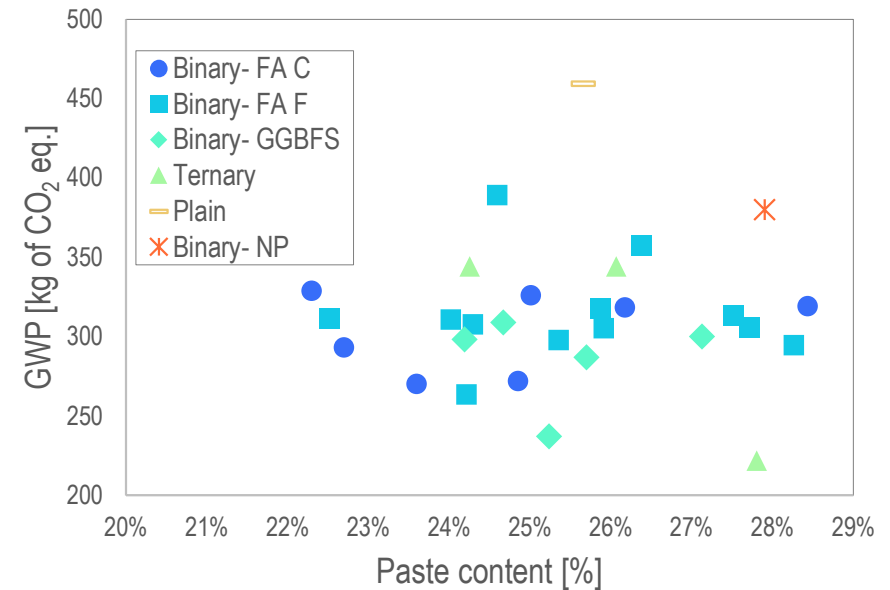
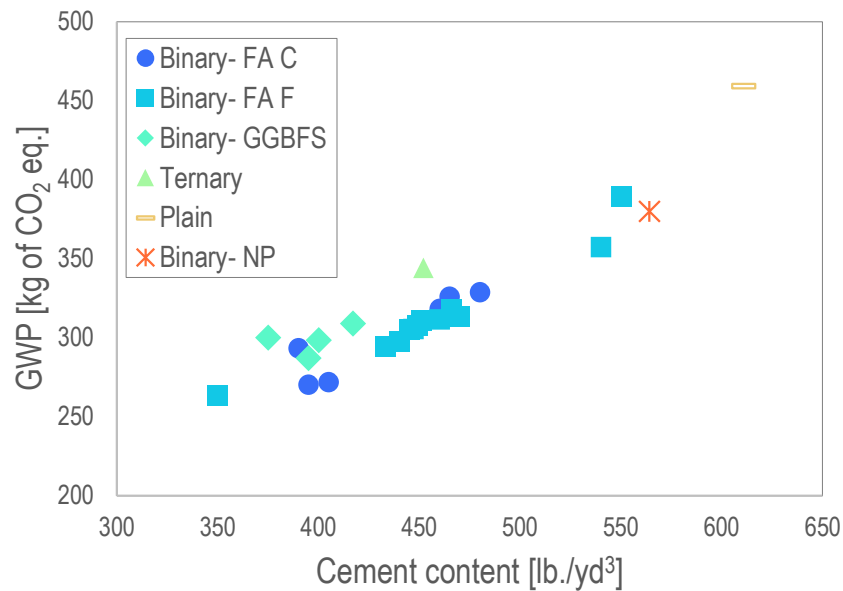
Source: FHWA

- Most mixtures use cementitious content in the higher range of specifications.
- 17 mixtures have paste content above 25 percent (AASHTO PP84).

AASHTO PP84 is a voluntary industry specification. Its use is not required by Federal law.



GWP vs. Mixture Design

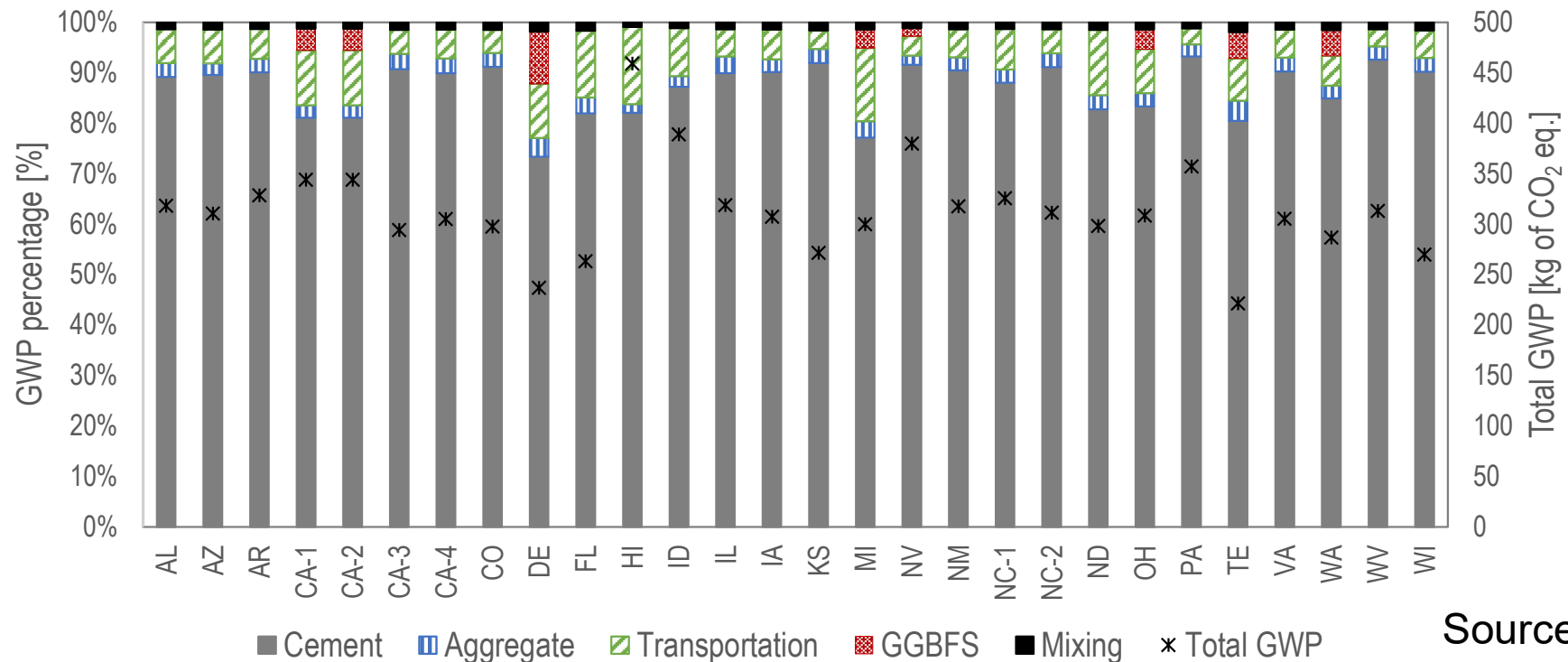


Source: FHWA

- Strong positive linear correlation between cement content and GWP.
- Increase in paste content leads to GWP increase.



Process Contributions

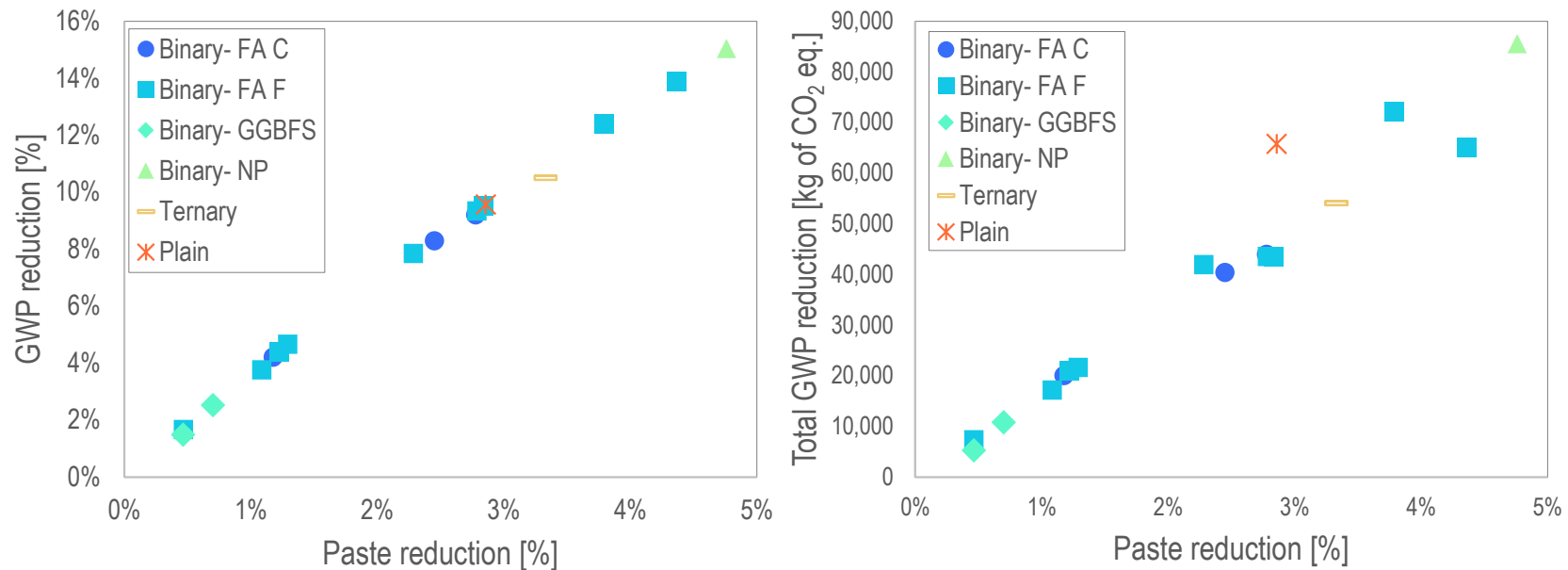


Source: FHWA

- With contribution of 73-93%, cement is the most significant contributor to GWP.
- Other processes with noteworthy contribution include transport and slag processing.



Potential Savings in Analyzed Projects



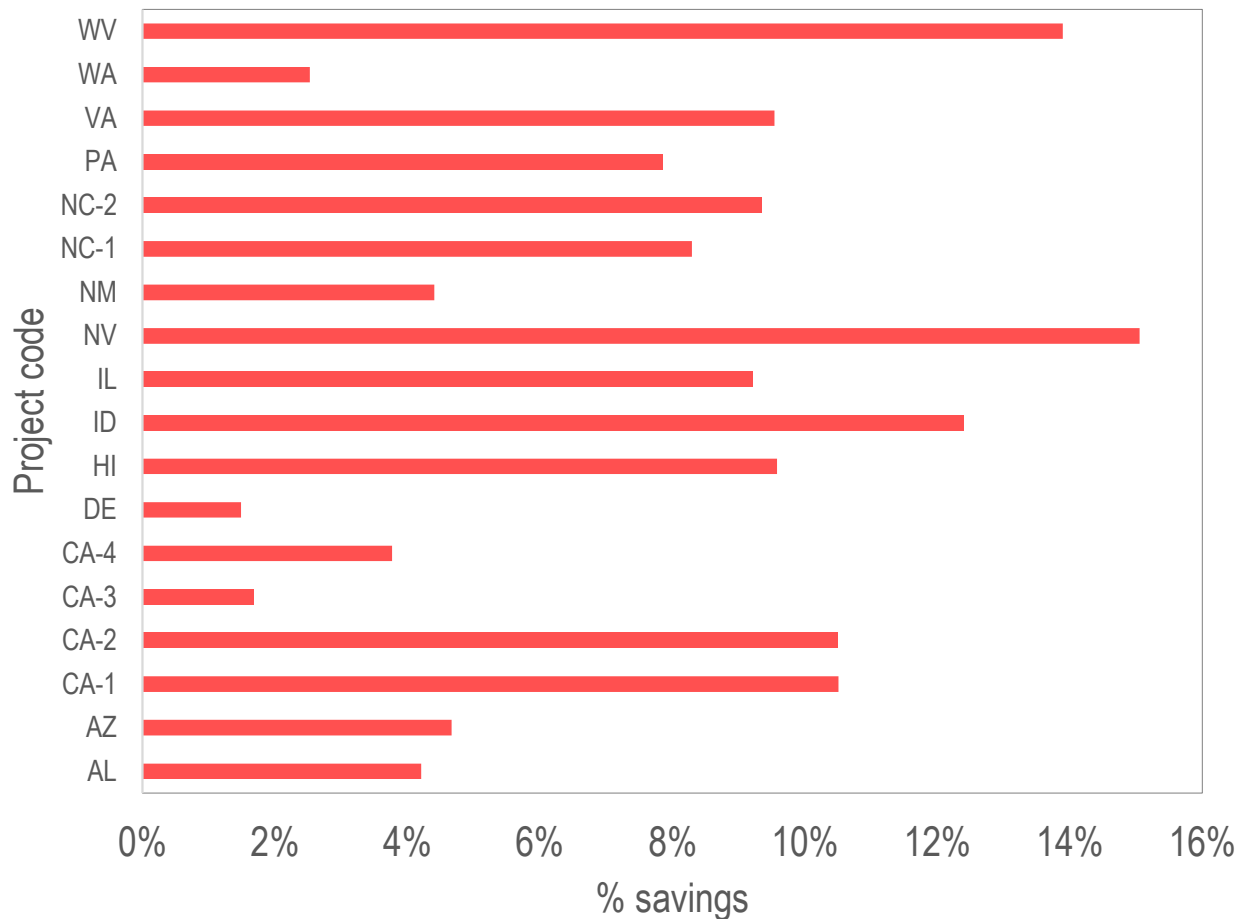
Source: FHWA

- % of GWP savings are proportional to % in paste reduction.
- Total savings per 1 lane mile can amount to removing up to 27 commuters from the road for a year.



Potential Savings in Analyzed Projects

% savings in embodied carbon when paste content is reduced to 25%



Reducing paste content to recommended 25% is:

- Providing improved performance
- Reducing embodied carbon by up to 16%
- Captured in EPDs
- Readily implementable
- Cost-effective



Concrete Pavement Decarbonization Strategies from the Literature

Strategy	Readiness level	Carbonation management level	Lifecycle phase	Economic indicators	Stakeholders
CO ₂ curing	Medium	Offset	Material production	Higher cost	Concrete producers
Material efficient design	High	Reduce	Material production	Lower cost	Concrete producers and State DOTs
Material substitution	High	Replace	Material production	Lower cost	
Service-life extension	High	Offset	Use	Depends	
Increased EOL carbonation	High	Offset	EOL	Higher cost	State DOTs and contractors

Source: FHWA



CLOSER LOOK AT EPDs

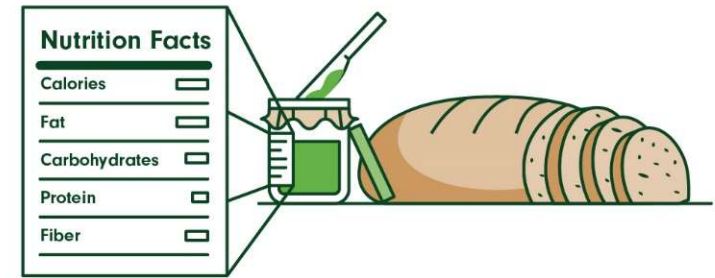




What Are EPDs?



- 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 required by Federal law or regulation.

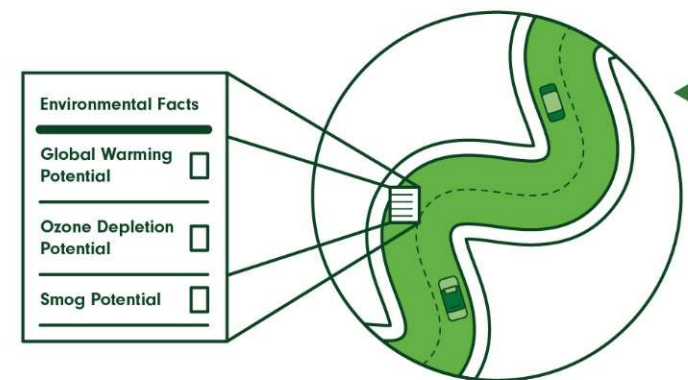


Similar to nutrition labels for food products, EPDs communicate critical environmental information on pavement materials to the customer.

Using guidance from ISO and European Standards,



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

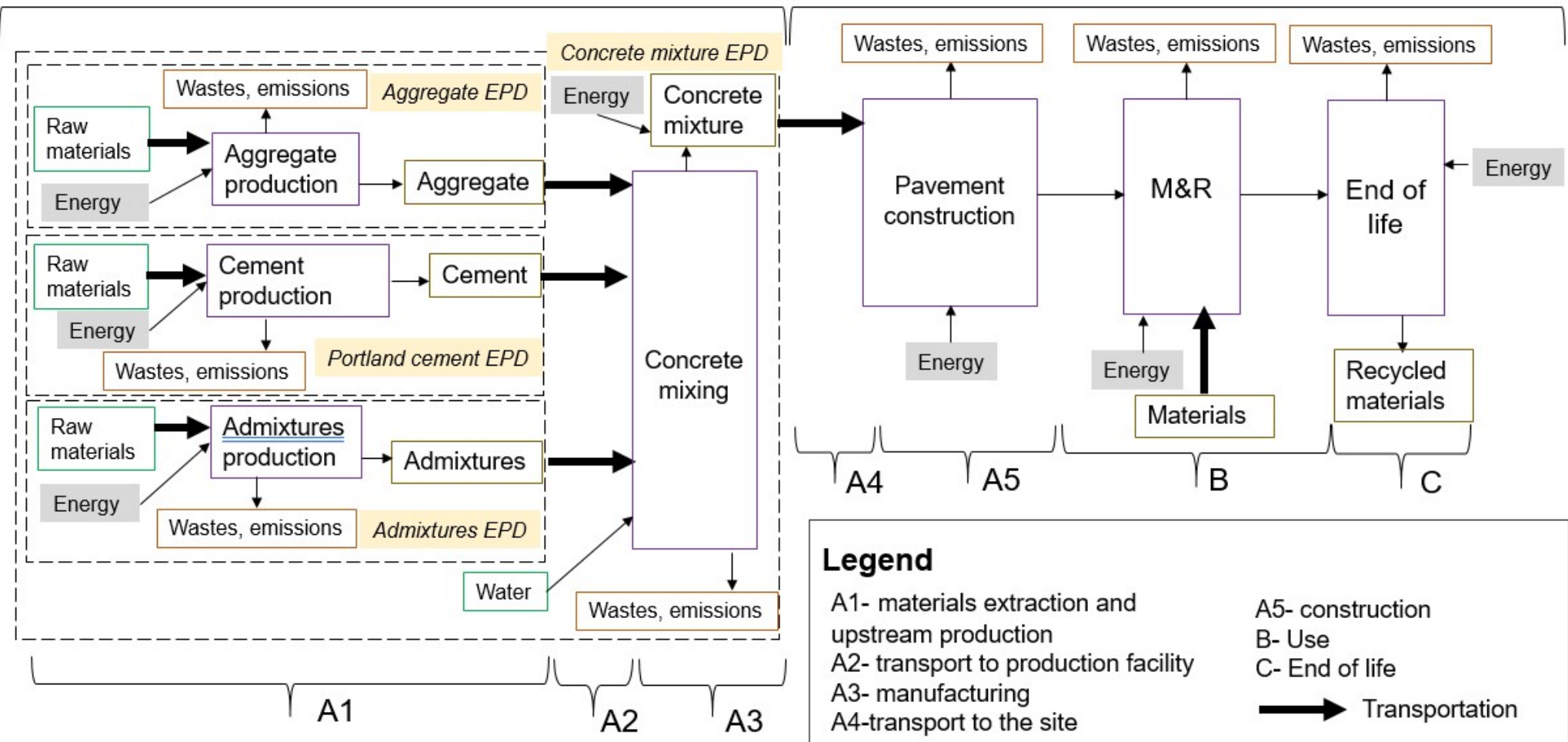




Pavement Product System

Material manufacturers

Transportation agencies and contractors

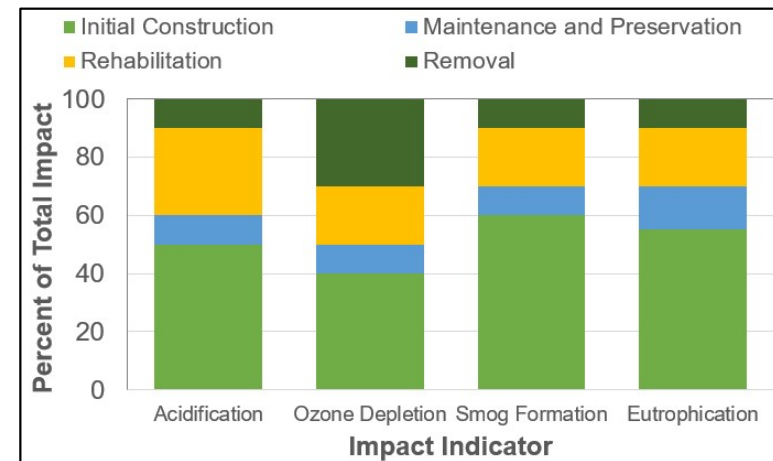
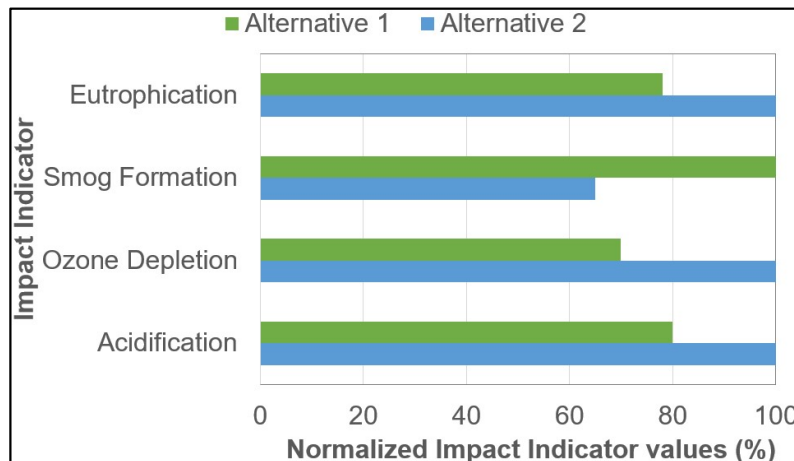




LCA Benchmarking Tool



- Created with stakeholder input
- Use the identified background datasets
- Incorporate material EPDs



Available at: <https://www.fhwa.dot.gov/pavement/lcatool/>



Would you like to get involved?

- Register for SPTWG Meeting – [SPTWG Website](#)
- Join the newsletter – [Join to become a SPP Friend](#)
- Request LCAPave Demo - email LaToya.Johnson@dot.gov
- Learn about pooled fund – [Pooled Fund Solicitation](#)
- Learn about Climate Challenge- [Climate Challenge](#)
- Learn about our resources –next slide



Resources



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](#)

[Mobile Pavement Technologies Centers](#)

[Informing pre-engineering with ICE Tool](#)



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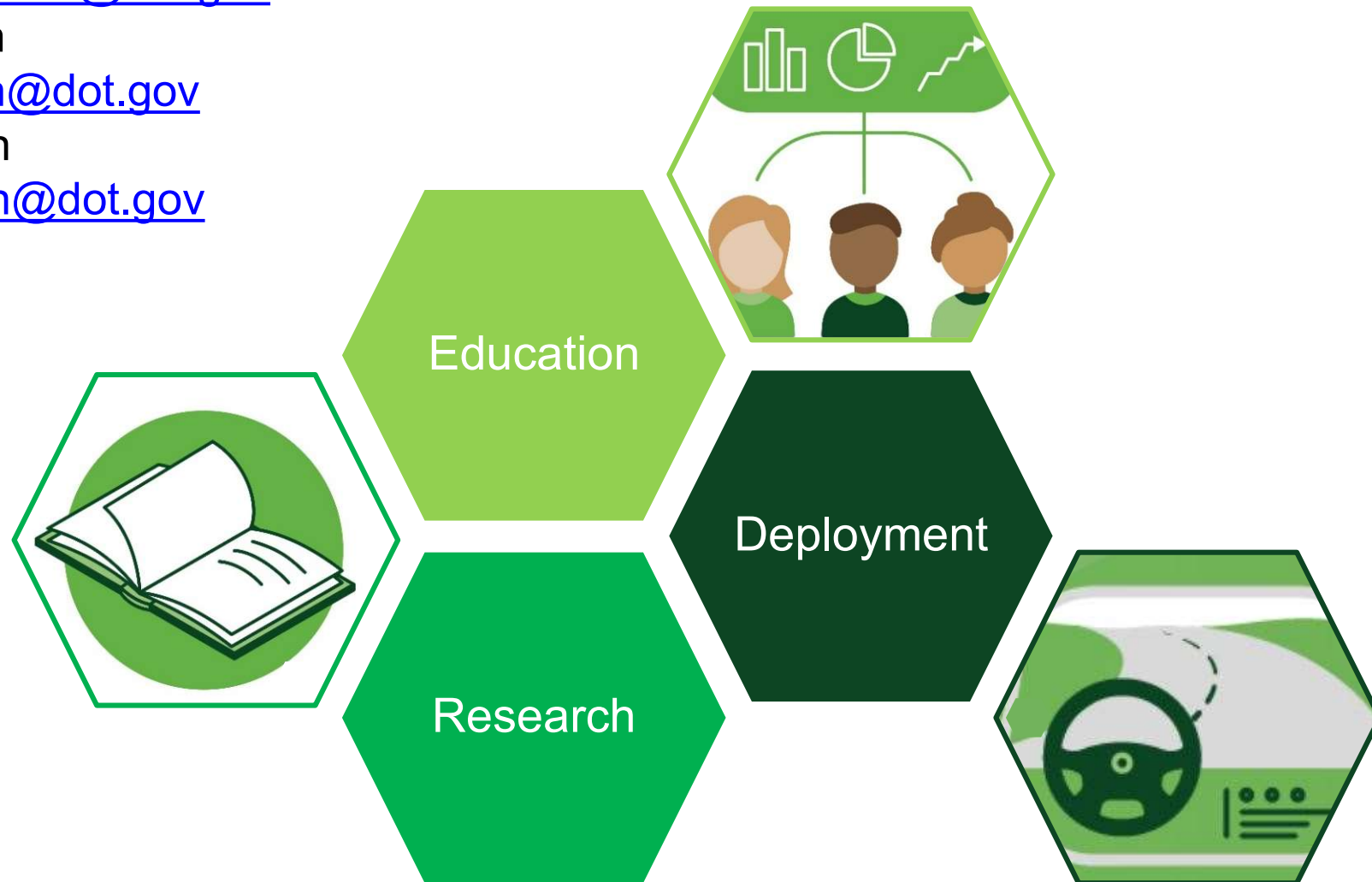
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<http://www.fhwa.dot.gov/pavement/sustainability>