



U.S. Department of Transportation  
Federal Highway Administration

# FHWA'S MOVEMENT TOWARDS MORE SUSTAINABLE PAVEMENTS

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# The Sustainability Triple Bottom Line



# US DOT Committed to Sustainability

"Sustainability must be a principle reflected in all our infrastructure investments, from highways and transit to aviation and ports."

Former Secretary Ray LaHood, March 2009

# US DOT Sustainability Policy Statement

DOT will incorporate sustainability principles into our policies, operations, investments and research through innovative initiatives and actions such as:

- Infrastructure investments and other grant programs
- Innovative financial tools and credit programs
- Rule- and policy- making
- Research, technology development and application
- Public information
- Enforcement and monitoring

*Signed Secretary Anthony R. Foxx, June 2014*

# Sustainable Transportation

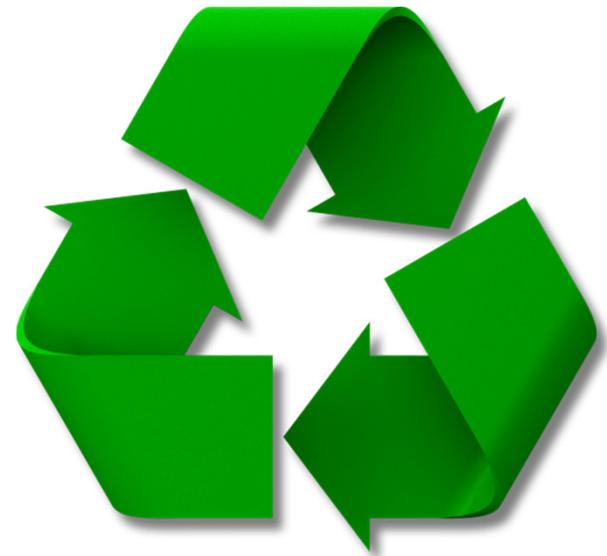
**Sustainable Transportation** means providing exceptional mobility and access in a manner that meets development needs without compromising the quality of life for future generation

- Safe
- Healthy
- Affordable
- Renewable
- Operates fairly
- Limits emissions and the use of non-renewable resources



# Sustainable Highways

- Consideration of the highway system:
  - From conception to completion
  - Includes maintenance and operations
  - Satisfies life-cycle functional requirements
  - While ideally improving the natural, built, and social environment



# FHWA Sustainable Pavements Program

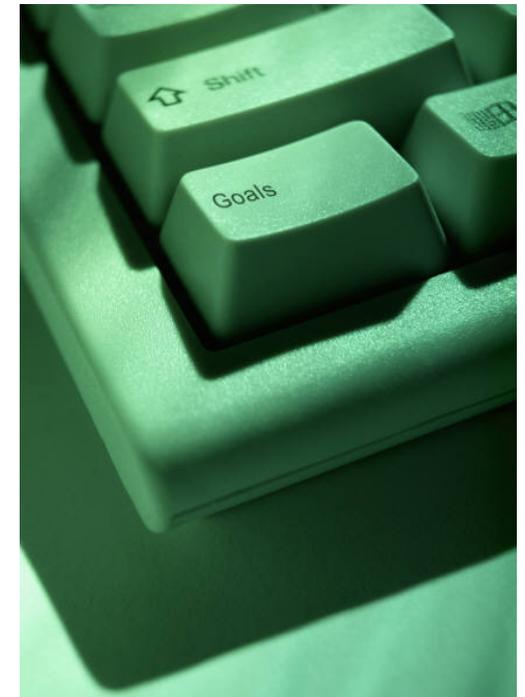
## *Goals*

- Support the US DOT goals for liveability and sustainable transportation
- Documents the body of knowledge regarding sustainability of asphalt and concrete materials in pavement design, construction, preservation, and maintenance
- Increase the use of sustainable technologies and practices in pavement design, construction, preservation, and maintenance

# FHWA Sustainable Pavement Program

- Technical input from stakeholders
- Technical guidance on pavement and materials sustainability
- Advancing sustainability tools
- Technology transfer

*The contractor team is lead by AP Tech with the assistance of NCE, UC-Davis, U of IL, U of WA, theRightEnvironment, and Mark Snyder (consultant)*



# Technical Input from Stakeholders

## Sustainable Pavements Technical Working Group

- The SP TWG is composed of stakeholders in State DOT's, academia, industry, and other government agencies
  - 20 members and 200+ friends
- Goal is for FHWA to gather feedback from stakeholders on the technical aspects of pavement sustainability



# Technical Guidance of Pavement and Materials Sustainability

- Develop guidelines for the design, construction, preservation, and maintenance of sustainable pavements utilizing asphalt and concrete materials
  - Educate practitioners on what sustainability means for pavements and materials
  - Encourage practitioners to adopt sustainable practices



# “Towards Sustainable Pavement Systems: A Reference Document”

1. Introduction
2. Concepts of Pavement Sustainability
3. Sustainable Materials for Paving
4. Design of Sustainable Pavements
5. Construction of Sustainable Pavements
6. Use Phase Considerations
7. Maintenance / Preservation / Rehabilitation Practices
8. End of Life for Sustainable Pavements
9. Sustainable Pavements in Livable Communities
10. Assessing Pavement Sustainability
11. Concluding Remarks

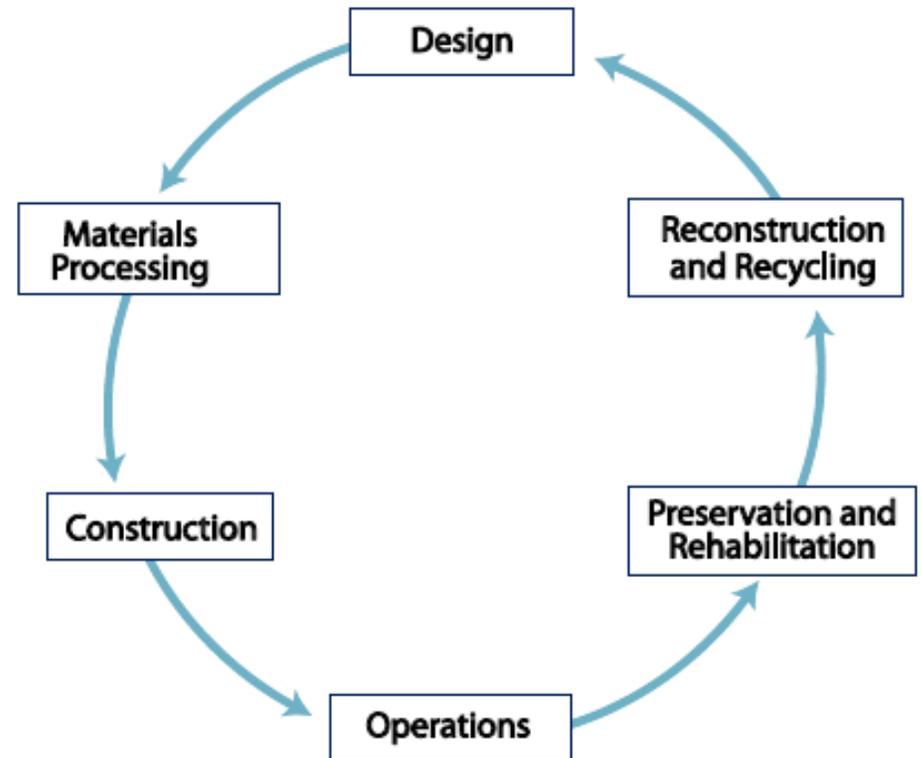
# 1. Introduction



- Target Audience
  - State department of transportation practitioners
  - Designers
  - Maintenance engineers
  - Materials engineers
  - Construction engineers
  - Inspectors
  - Planners
  - Others who will benefit: local roadway agencies, industry, academia, public interest groups
- What is sustainability and why do pavements matter?

## 2. Concepts of Pavement Sustainability

- Sustainability definitions
- The pavement life cycle
  - Materials production
  - Pavement design
  - Construction
  - Use
  - Maintenance and preservation
  - End-of-life
- Introduction to assessment
- Consideration of trade-offs

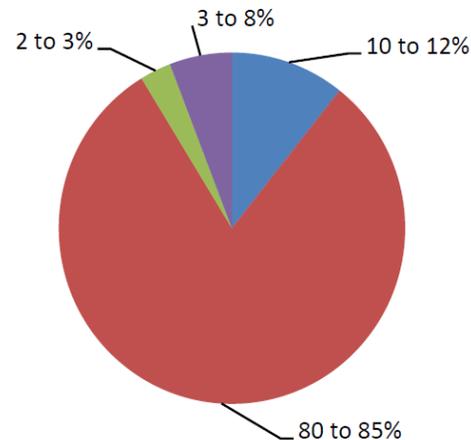


# 3. Materials Considerations to Improve Pavement Sustainability

## Aggregates

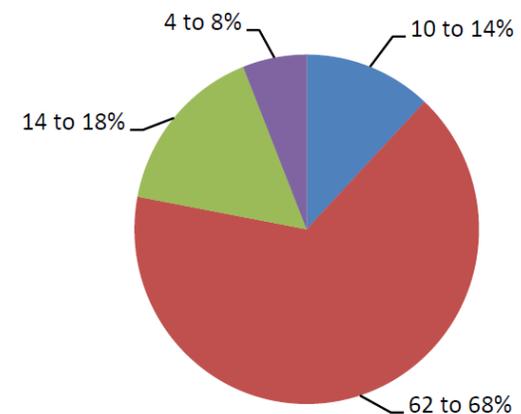
Percentage of Volume of Typical Asphalt Concrete

■ Asphalt Binder ■ Aggregate ■ Filler ■ Air



Percentage of Volume of Typical Concrete

■ Cementitious ■ Aggregate ■ Water ■ Air



- Strategies

- Reduce amount of virgin aggregate used
- Reduce impact of virgin aggregate acquisition and processing
- Reduce impact of transporting aggregate

# 3. Materials Considerations

## *Concrete Materials*

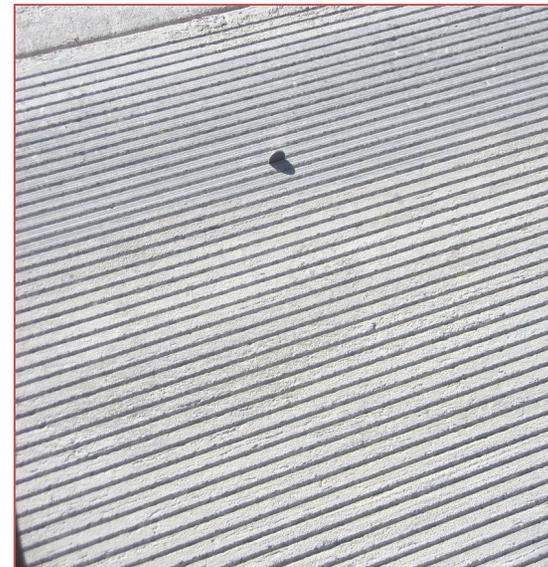
- Strategies
  - Reduce energy consumption and emissions during cement manufacturing (biofuels, minimize clinker, etc.)
  - Reduce energy consumption and emissions during concrete production (blended cements, SCMs, etc.)
  - Increase use of recycled, co-product and waste materials
  - Improve concrete durability



## 4. Pavement and Rehabilitation Design to Improve Sustainability

- Strategies
  - ME Design for optimization
  - Enhanced pavement smoothness over the life-cycle
  - Noise reducing surfaces
  - Minimize impacts of utility cuts
  - Permeable pavements

Next Generation Diamond Grinding



# 5. Construction Considerations to Improve Pavement Sustainability

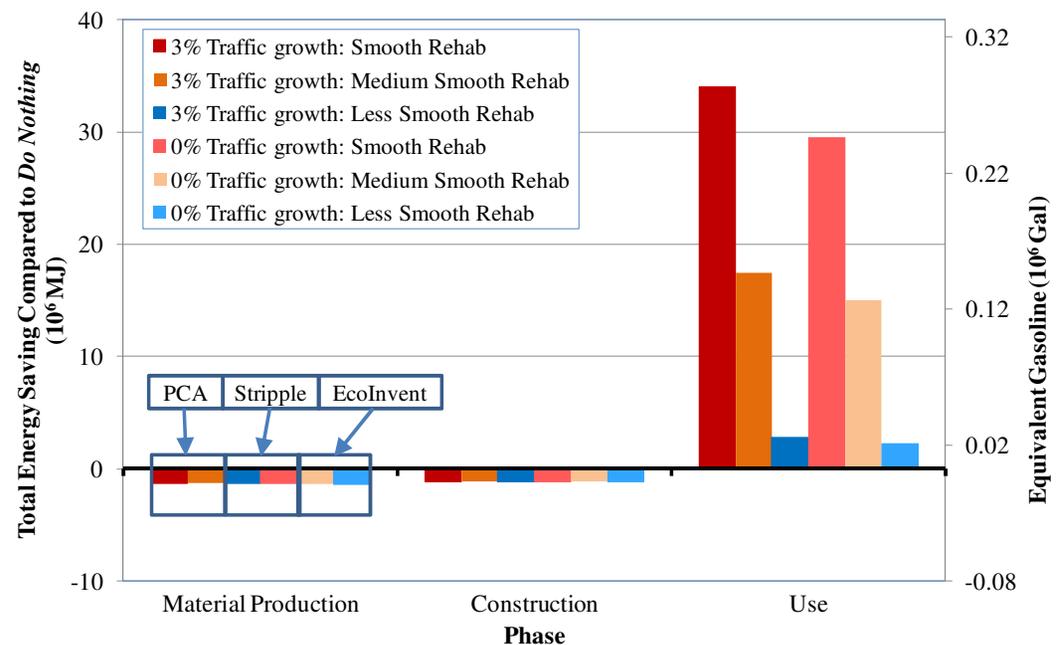
## *Concrete Construction*

- Strategies
  - Protect water resources
  - Improve initial ride quality
  - Increase pavement service life
  - Balance surface friction and tire-pavement noise



## 6. Use Phase Considerations

- Major Issues
  - Impact of vehicle-pavement interaction on fuel consumption and emissions
  - Tire-pavement noise
  - Stormwater runoff
  - Pavement thermal performance (urban heat island)
  - Safety



## 7. Maintenance and Preservation Treatments

- Lower life cycle cost are often highly correlated with lower environmental burden
  - Treatment selection, materials selection, and timing of treatment
- On higher traffic routes, high economic cost of more frequent treatments may be offset by large reductions in environmental impacts
- Treatment, materials, and construction quality play a major role



# 8. End of Life

## *Concrete Pavement Recycling*

- Strategies
  - Increase use of recycled materials
  - Reduce CO<sub>2</sub> emissions over life cycle through sequestration
  - Reduce virgin materials

Recycled concrete  
aggregates



## 9. Pavement Sustainability Within Larger System

- Sustain communities
  - Enhance roadway aesthetics, cultural identity
- Sustain ecosystems
- Improve worker and community health: reduce odors, soot, and particulate
- Balanced approach to allowable hours of construction

Zion Park Blvd. in Utah (SR 9);  
photo from Dr. Steve Muench

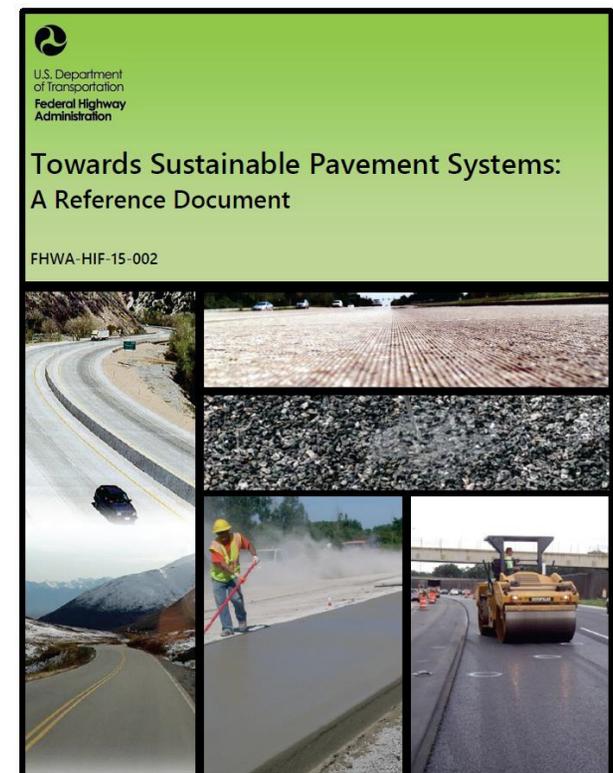


# 10. Assessing Pavement Sustainability

- Economic life cycle cost analysis (LCCA)
  - Evaluation of the total economic worth of a usable project segment
    - FHWA RealCost
- Sustainability rating systems
  - List of sustainability best practices with an associated common metric
    - FHWA INVEST, Greenroads, Envision, GreenLITES, LEED
- Environmental life cycle assessment (LCA)
  - Quantifies environmental impact over the full life cycle of a product or system

# Current Status

- Publication-ready document submitted to FHWA in December 2014
- March/April 2015: Final published document
- Technology Transfer
  - Will be available on FHWA web page
  - Hard copies and electronic version
  - Webinars will be announced Spring 2015



# Advance Sustainability Tools

## Pavement Life Cycle Assessment (LCA) Framework

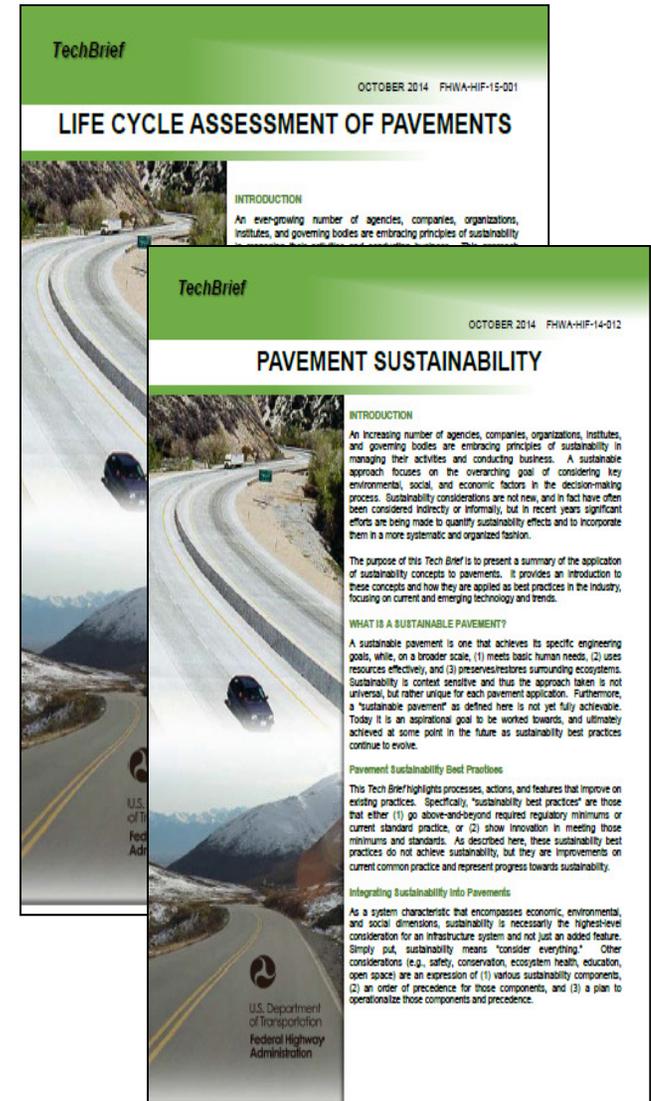
- Evaluation methodology that quantifies environmental impacts
- Comprehensive approach to evaluating the total environmental burden of a product
- Examines all environmental inputs and outputs over the life cycle
- Consideration from materials production to end-of-life

*First Draft- Spring 2015*  
*Final Draft- September 2015*



# Technology Transfer

- Tech Briefs (*published*)
  - Life-Cycle Assessment
  - Pavement Sustainability
- Tech Briefs (*in development*)
  - Climate Change & Pavements
  - Best Practices for Sustainable Asphalt Pavements
  - Best Practices for Sustainable Concrete Pavements



# Technology Transfer

*Moving from Paper to Practice*

- Updated FHWA Sustainable Pavements website ([www.fhwa.dot.gov/pavement/sustainability/](http://www.fhwa.dot.gov/pavement/sustainability/))
  - Technical Articles
  - Reference Center

The FHWA launched the Sustainable Pavements Program in 2012 to address the knowledge and practice of sustainability related to pavements. The overall objective is to establish a program that considers capital, economic, growth, and other impacts in pavement systems including new and emerging materials. A critical outcome of the program is to increase the awareness, visibility, and the body of knowledge of sustainability contributions to all the life cycle phases of pavement systems.

**Reference Center**  
This section provides access to the sustainability pavements reference documents and other useful agency articles from the document that cover key topics and core issues.

**Technology Transfer**  
This section provides access to the Tech Briefs showcasing the key concepts related to key pavement sustainability topics. Information and presentation materials on past and upcoming pavements sustainability programs are also provided.

**Technical Working Group**  
The FHWA established a Sustainable Pavements Technical Working Group (SP-TWG) comprised of diverse stakeholders in the pavement and materials community including individuals from State Departments of Transportation and other public agencies, industrial partners. The focus of the

# THANK YOU

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

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