



NATIONAL ASPHALT  
PAVEMENT ASSOCIATION

# Pavement Economics Committee Projects and Initiatives

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Director of Sustainable Engineering



# Outline

- Pavement Economics Committee Background
  - Pavements Impact on Fuel Economy
  - Enhancements to Life Cycle Assessment Software to Include Pavement Smoothness
  - Unintended Consequences to Urban Heat Island
- Dissemination of Research Results

# Pavement Economics Committee (PEC)



# PAVEMENT ECONOMICS FUND

**Six NAPA-  
SAPA Task  
Groups**

**\$1  
Million  
Program**

**Funded by  
NAPA & SAPAs  
with 100%  
SAPA  
Participation**



# PEC TASK GROUPS

## Six NAPA-SAPA Task Groups



Best Quality and  
Competitiveness



Environmental  
Sustainability



Legislative



Pavement  
Design



Pavement  
Preservation



Pavement  
Type  
Selection



# PEC 2013 Projects

- Optimize Pavement Design & Materials
- Enhance Life Cycle Assessment Software to Include Pavement Smoothness
- Unintended Consequences of Reflective Pavements
- Develop Thinlays with High Recycled Content
- Prevent Passage of Pavement Type Mandates at State and National Level

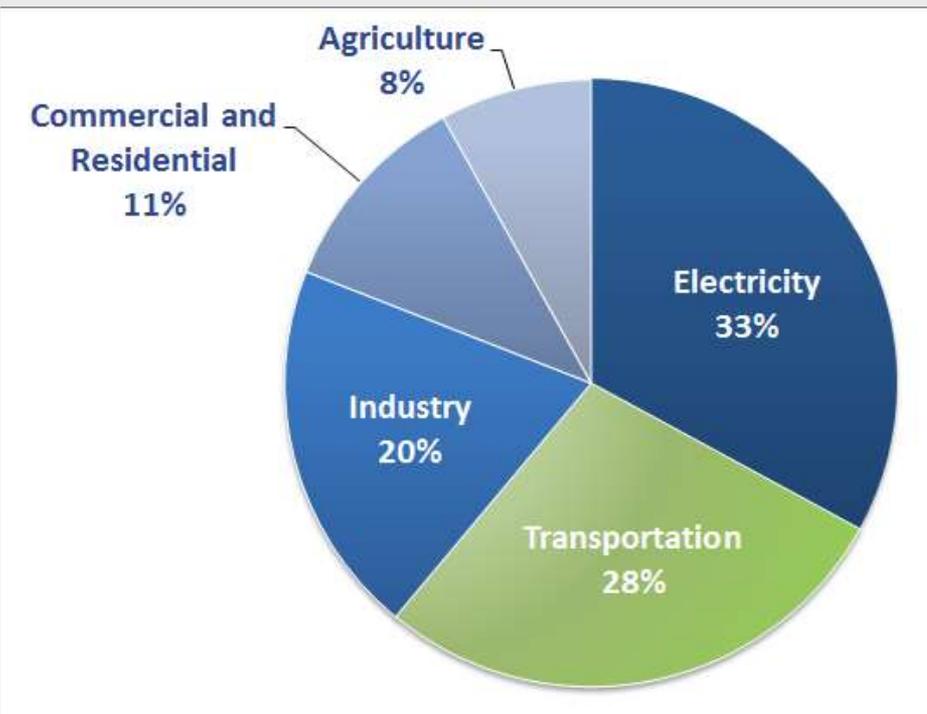
# How does Pavement Influence Fuel Economy?

National Center for Asphalt Technology  
Dr. Richard Willis  
Dr. Mary Robbins  
Dr. Marshall Thompson



# Project Motivation

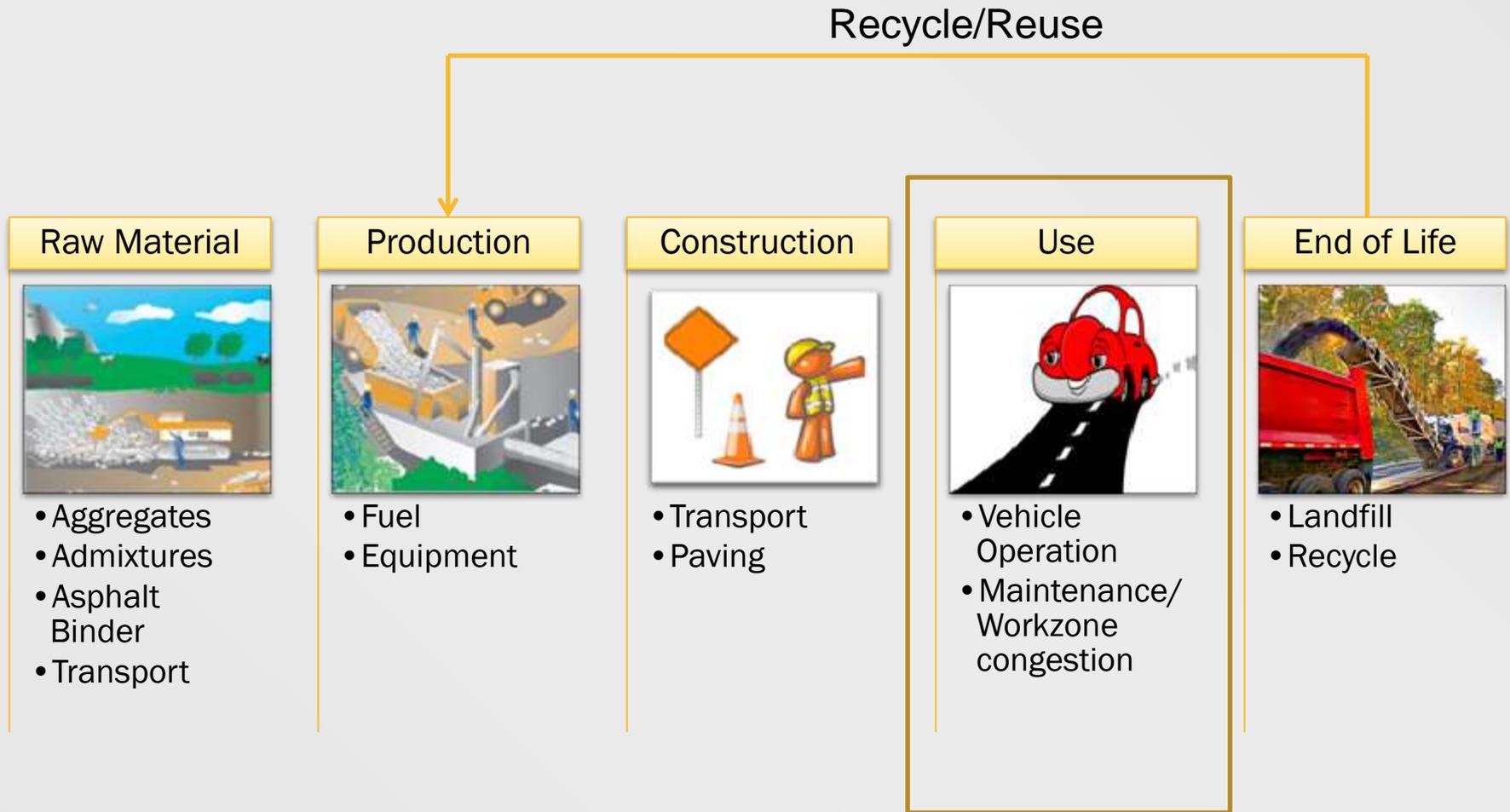
Total U.S. Greenhouse Gas (GHG) Emissions by Economic Sector in 2011



- 84% of the GHG from the transportation sector from vehicle combustion



# GHG associated with Pavements





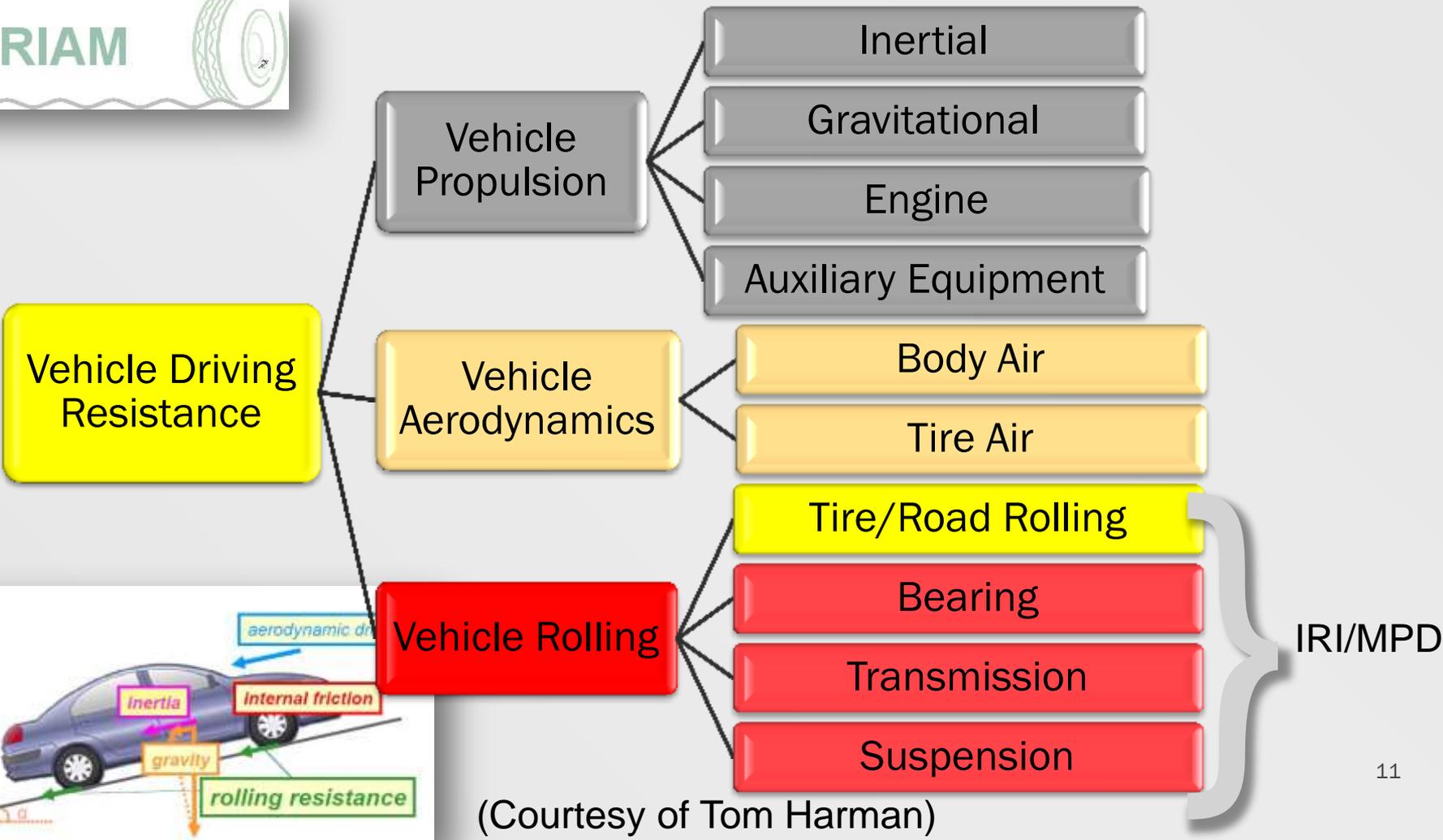
# Project Objectives

- How does pavement influence fuel economy?
- Goal: Synthesize existing literature on how pavement properties might alter the vehicle fuel economy



# Factors Effecting Fuel Efficiencies

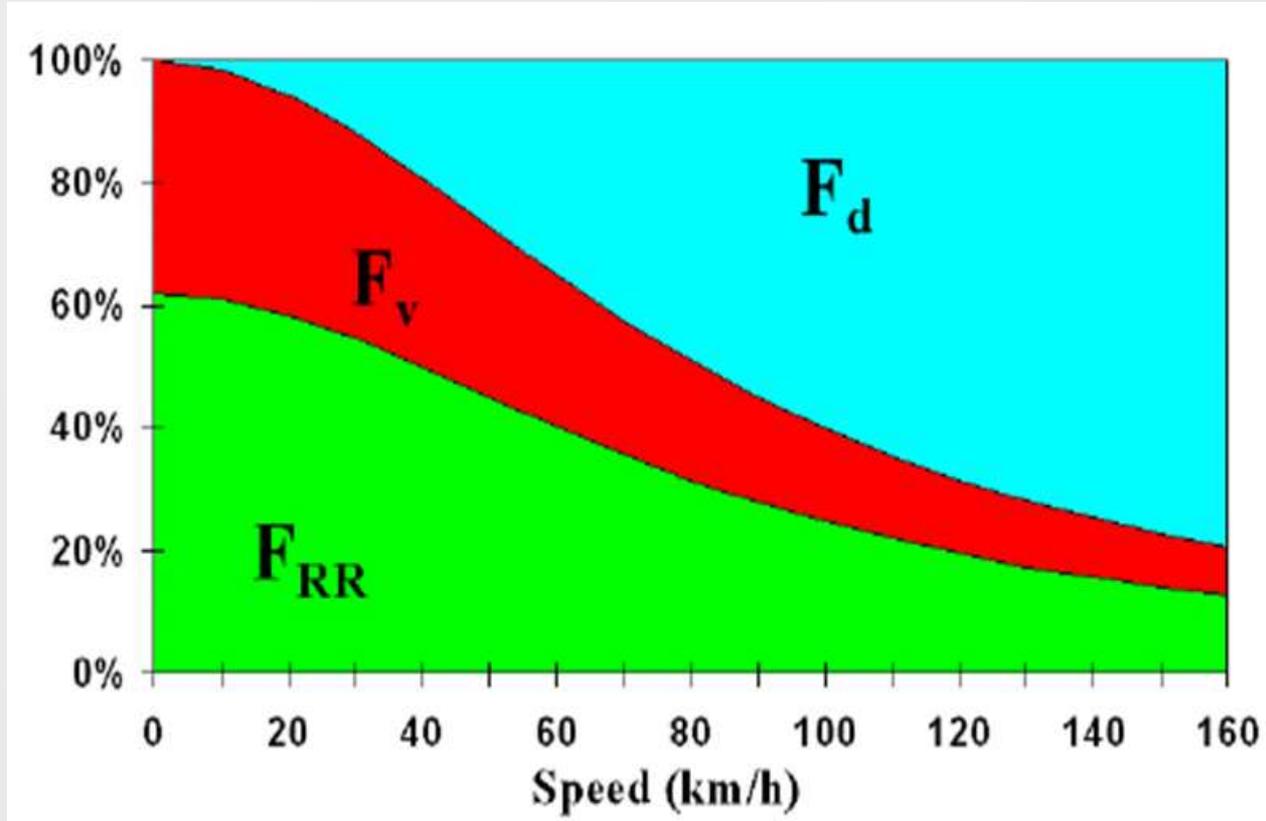
## Total Driving Resistance





# Rolling Resistance

- Force required to keep an object (i.e. wheel or tire) moving
- Energy Losses
  - Pavement Surface
  - Internal Friction
  - Tire Deformation



(Beauving, 2004)



# Factors Influencing Rolling Resistance



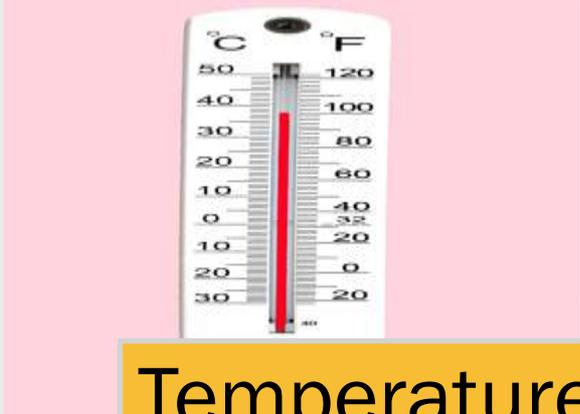
Tire Pressure



Pavement



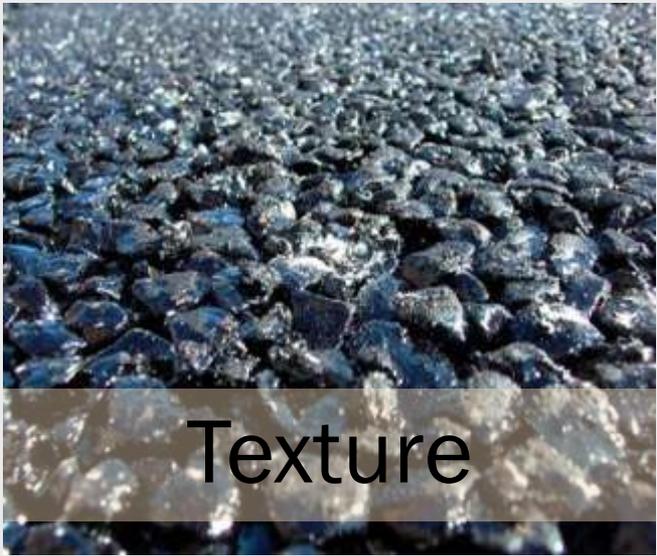
Speed



Temperature



# What factors can we control?





# Smoothness Matters

- Smoothness and texture have an effect of fuel economy
  - Macrotexture = 7% change in fuel economy (Sandberg, 1990)
  - Smoothest to roughest road = 11% change in fuel economy (Sandberg, 1990)
- Effect of pavement deflection unknown
  - Difficult to pull one property (stiffness) out when texture and smoothness also affect it
  - Conflicting results

# Enhance Life Cycle Assessment Software to Include Pavement Smoothness

Michigan Technological University  
Dr. Amlan Mukherjee  
Benjamin Ciavola  
Jay Vana



# Project Objective

- How does Pavement Smoothness Improve Environmental Life Cycle Impacts?
- Goal:
  - Create interface to compare smoothness of different pavement types
  - Enhance existing life cycle assessment (LCA) GHG software to include pavement smoothness



# Interface

- Long-Term Pavement Performance (LTPP) IRI data
  - Easy Access
  - Transparent
- Allow for customized assessment by stakeholders
  - Network
  - Pavement type
- Analyze FHWA LTPP data set
  - How does IRI change over time?
  - What conditions influence IRI?
  - What kind of maintenance plans deliver smooth pavements?



# Interface

Life Cycle Solutions

By Section

By Pavement Type

By Network

California 3005 Select



More

Highcharts.com

## US-5

### JPCP Over Non-Bituminous Treated Base

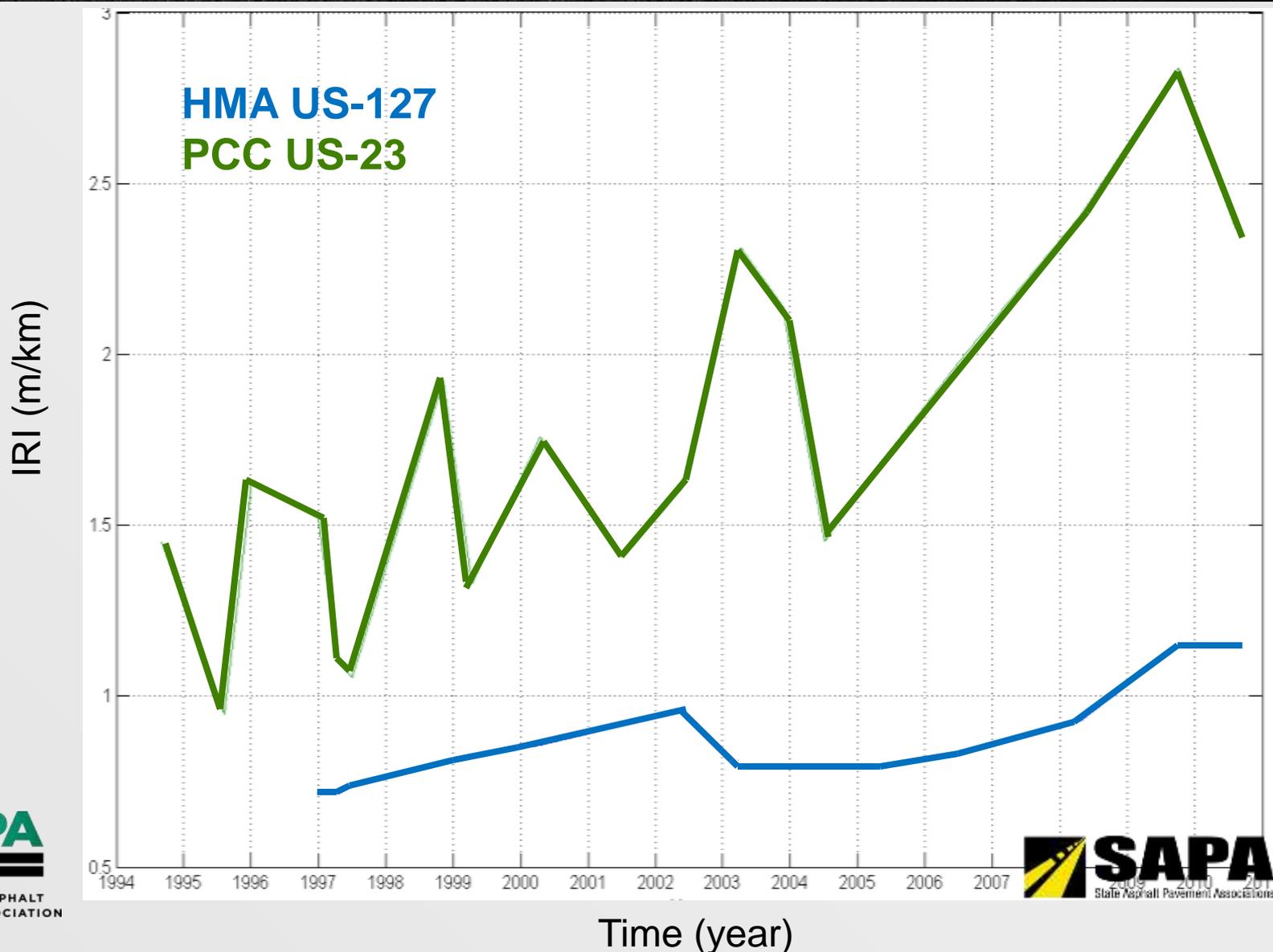
#### ESAL: 1612,000, Experiment 3 (GPS)

- 1 May 1996:** Skin Patching, Full-Depth Patching of PCC Pavement Other Than at Joint
- 1 July 1999:** Full-Depth Patching of PCC Pavement Other Than at Joint
- 1 July 2000:** Lane-Shoulder Longitudinal Joint Sealing, Crack Sealing, Full-Depth Patching of PCC Pavement Other Than at Joint, Transverse Joint Sealing
- 1 July 2002:** Full-Depth Patching of PCC Pavement Other Than at Joint
- 1 April 2004:** Lane-Shoulder Longitudinal Joint Sealing, Crack Sealing, Transverse Joint Sealing





# Pavement Comparisons





# Project Next Steps

- Relate fuel efficiency as a function of change in IRI to
  - Maintenance schedules
  - Pavement type
  - Regional factors
- Estimate use phase emissions PE-2

Highway Construction | www.construction.mtu.edu/cass\_reports/webpage/mat\_estimator.php

PE-2 Project Emission Estimator

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**PE-2 TOOL**

- Material Estimator
- Emission Estimator
- LCA Estimator

**MATERIALS ESTIMATOR**

The PE-2 Material Estimator allows the user to generate emission reports that estimate the carbon dioxide emissions associated with materials used in highway construction projects. Materials are classified according to MOOT's Standard Specifications for Construction's Division 8 material classification. The tool estimates cradle-to-gate emissions and can be used to differentiate impacts of using composite materials that make up the roadway. This tool can be used by a contractor or an owner. Before using the tool the investigator should have a complete bill of materials.

**BUILD MATERIALS LIST**

Materials Table:

901 Fly Ash Quantity:  Ton

Division	Material Number	Material Description	Material Unit	Quantity	Emissions	Method
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0 MT of CO2

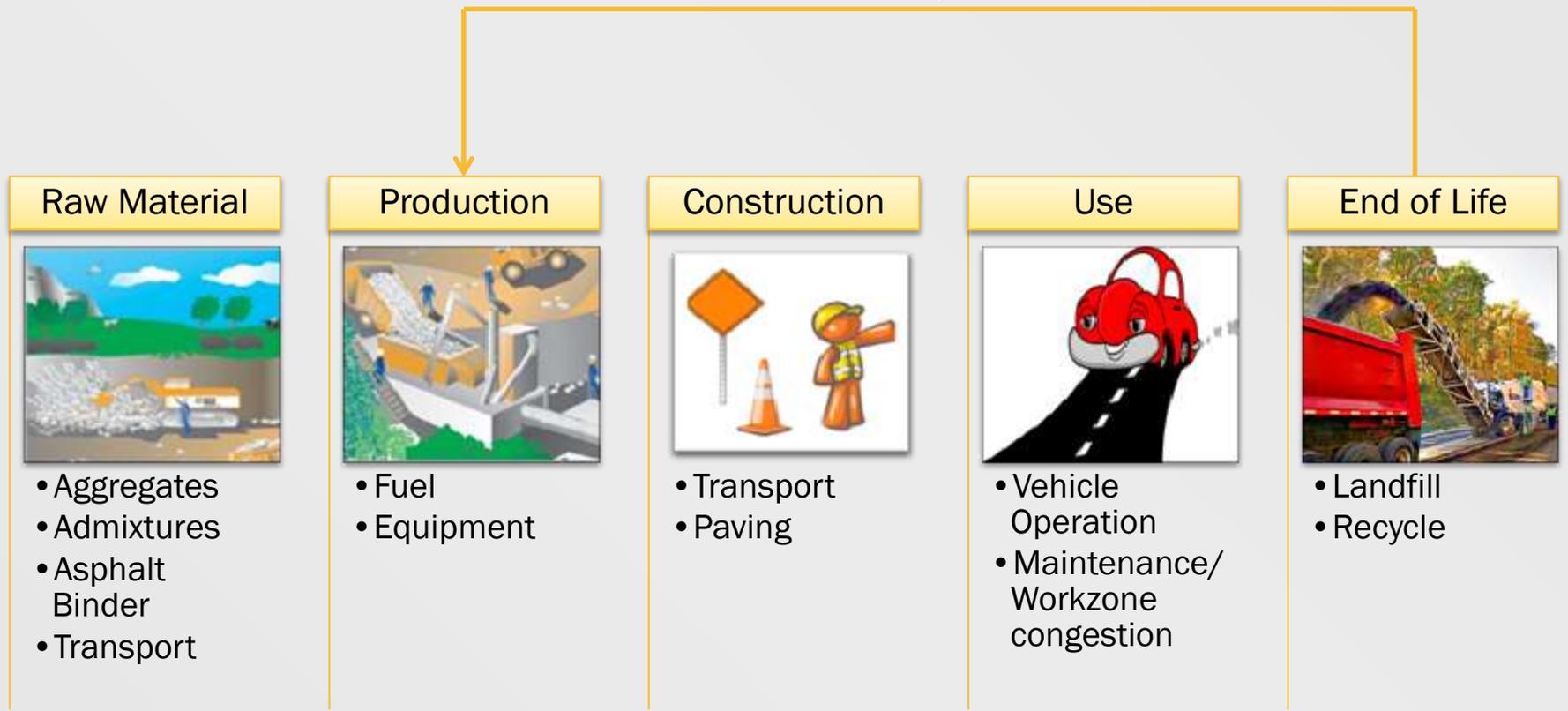
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# Project Next Steps

## Recycle/Reuse



# Unintended Consequences of Reflective Pavements

Arizona State University  
Dr. Kamil Kaloush  
Dr. Zhihua Wang  
Jiachuan Yang



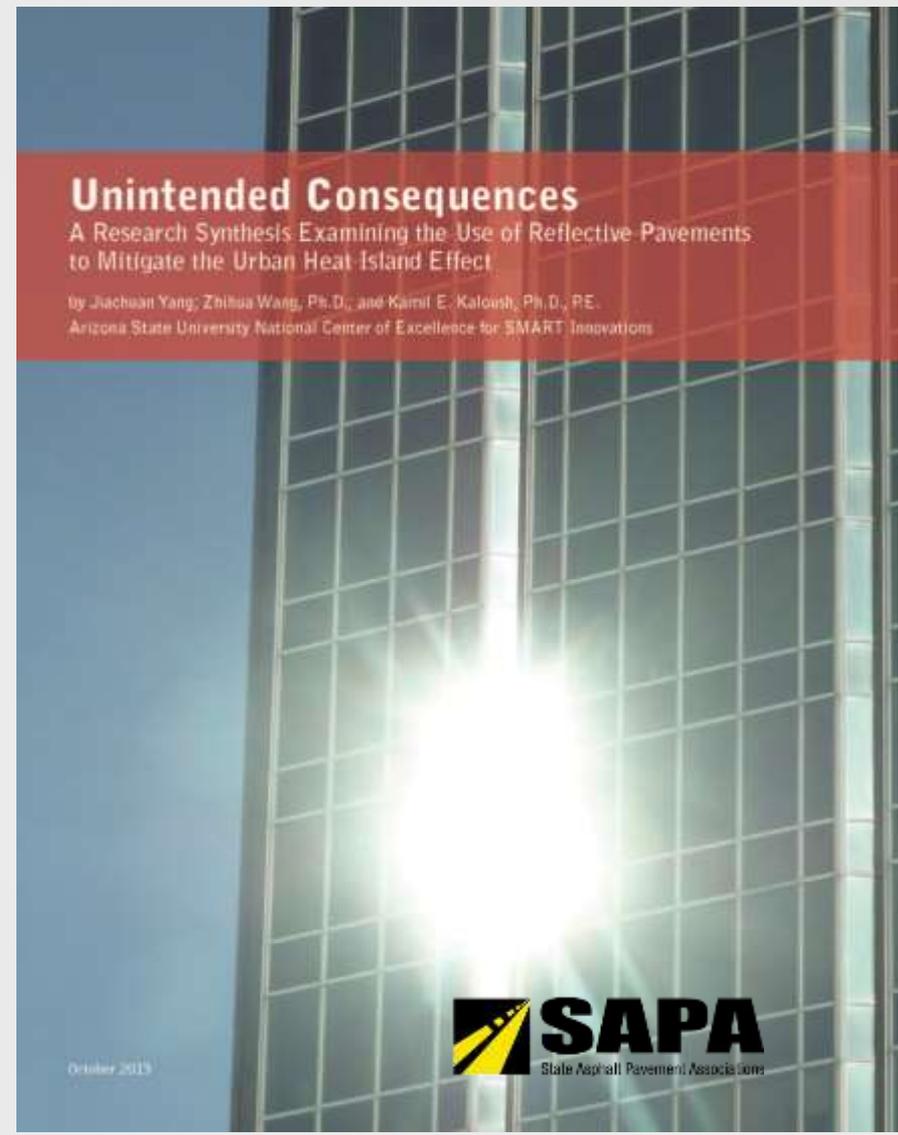
# Project Objective

- State and federal legislation, as well as green building codes increasingly penalize and/or prohibit pavements with low reflectivity to mitigate Urban Heat Island (UHI).
- Goal:
  - Illustrate the complexity UHI
  - Identify the tradeoffs with pavement reflectivity



# UHI – UNINTENDED CONSEQUENCES

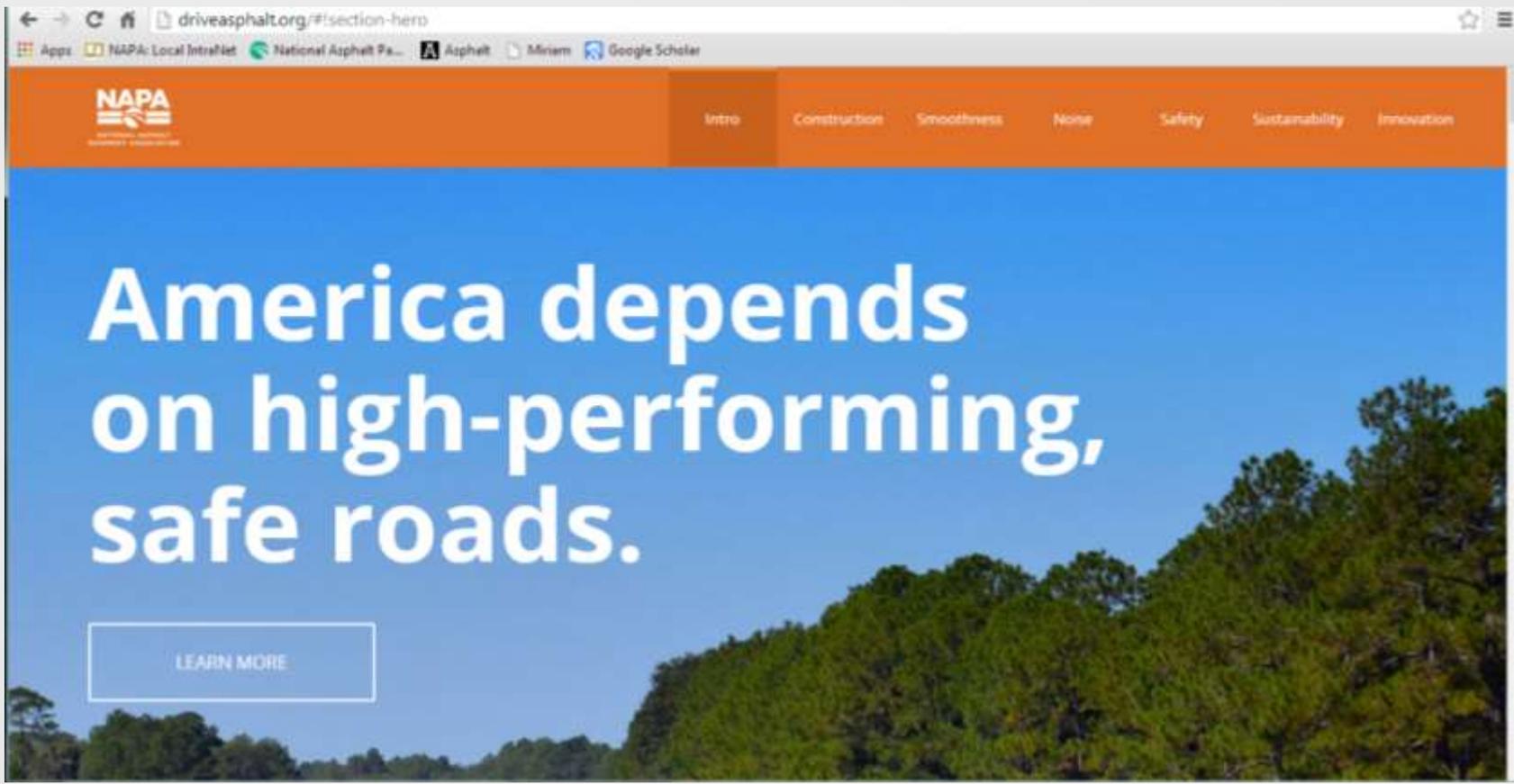
- Increased atmospheric heating
- Decreased rainfall
- Increased heating of adjacent walls
- Air temperature above pavement is the same



# Dissemination of Research Results



# Driveasphalt.org





# NAPA MEMBERSHIP

- Three reasons why you should join.
  1. NAPA's professional staff become members of your staff.
  2. NAPA is always on the cutting edge of technology and thus NAPA members will always be more competitive than non members.
  3. NAPA protects your investment by making sure you have a market to operate effectively in.
- It costs less than 2 cents a ton



# QUESTIONS

2014 Midyear Meeting: July 14 – 16, Nashville  
NAPA Asphalt Fly In: September 9 – 10, 2014  
Young Leaders Conference: Fall 2014  
2015 Annual Meeting: January 25 – 28, Marco Island

## SAVE THE DATES

2014  
UPCOMING  
NAPA EVENTS  
2015



NAPA's meetings are renowned for their educational content—ideas that attendees can take home and use directly to make their businesses grow. They are also the asphalt industry's premier gathering places, with unique networking and forums for information exchange.



Questions?  
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