

# Warm Mix Asphalt *“National Perspective”*

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# WMA Technologies Available in U.S.

In 2005





# WMA Technologies Available in U.S.

In 2012

30+





# WMA Technologies Available in U.S.



... and  
beyond





# General Technology Categories



## Material Processing

- Ex. LEA (Hot Coated Coarse Agg + Moist Fine Agg + Additives)



## Organic Additives

- Waxes, Zeolite



## Chemical Additives

- Surfactants



## Foaming Processing

- Water Injection, Zeolite





## Hybrid Systems

Ex. H<sub>2</sub>O + Surfactant



# Technology Overview\*\*

- Materials Processing
  - WAM-Foam  
  - Low Emission Asphalt



\*\*FHWA does not endorse any particular proprietary product or technology.



# Technology Overview\*\*

- Mix additives (Chemical)

- Evotherm (ET, DAT, 3G)



- REVIX (Evotherm 3G)

Mathy Tech. & Eng. Services and  
Paragon Technical Services, Inc

- Cecabase RT



- Iterlow-T; HyperTherm; QualiTherm



- Rediset LQ





# Technology Overview\*\*

- Mix additives (wax)

- Sasobit



- Rediset WMX



- SonneWarmmix



- Thiopave



- a sulphur extender used w/ WMA

- LEADCAP



\*\*FHWA does not endorse any particular proprietary product or technology.





# Technology Overview\*\*

- Mix additives (water bearing filler)

- Aspha-Min



- Advera





# Technology Overview\*\*

- Water injection at the plant

- Ultrafoam GX



- Terex 

- Double Barrel Green



& Green Pac

- Stansteel



- Aquablack

- ECOFOAM-II



- Meeker WMA



- AquaFoam



- Tri-Mix



\*\*FHWA does not endorse any particular proprietary product or technology.



# Technology Overview

- Many US technologies' web-link at:  
<http://warmmixasphalt.com/wmatechnologies.aspx>

warmmixasphalt.com



**WMA Technologies**

**Test Frameworks**  
 The Warm-Mix Asphalt Technical Working Group has devised test frameworks to help researchers obtain data in a uniform format so that analysis can be done by using data from a multitude of projects. There is one framework for **material properties** and another for **emissions and energy reductions**.

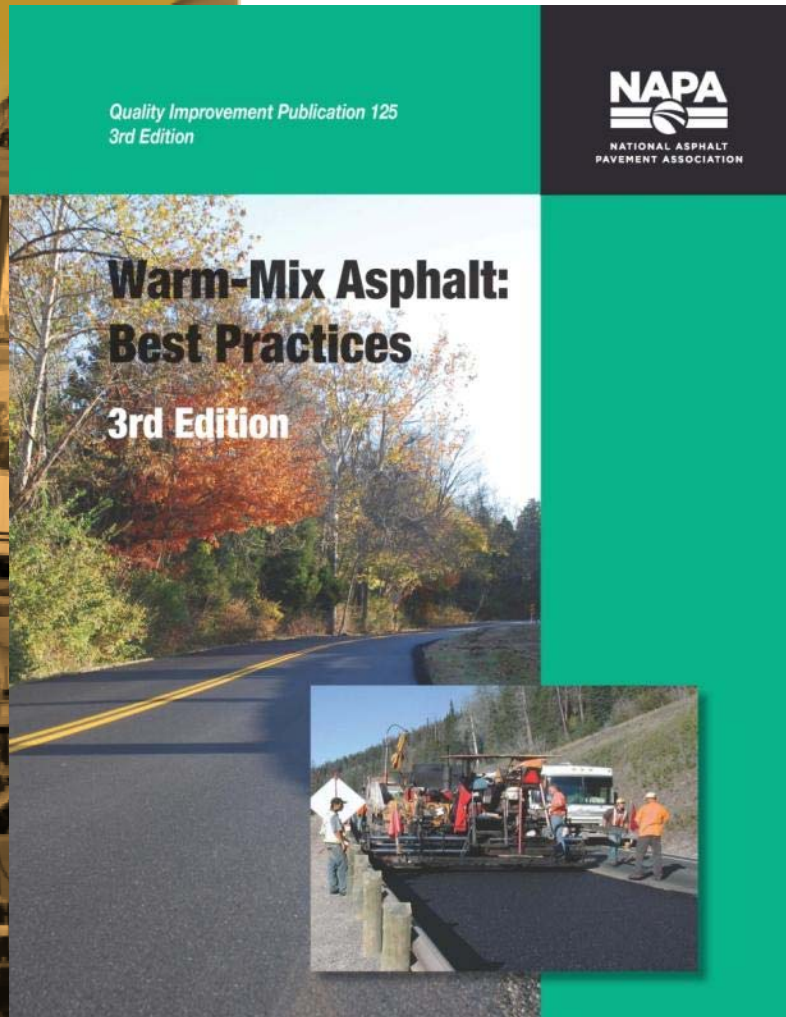
**Products and Processes**  
 This listing of products and technologies does not constitute an endorsement or approval. The composition, application, performance, and legitimacy of these listed technologies has not been determined. It is the responsibility of the user or specifying agency to determine the product or technology's merits for usage.

**PLEASE NOTE:**  
 The contents of this web site are to promote the understanding of warm-mix asphalt during its research and development phase in the United States. This web site cannot be used to promote or single out any one specific asphalt technology.

Advanced Concepts Engineering Co.: [LEA-CO](#) >>>  
 AESCO/Madsen: [Eco-Foam II](#) >>>  
 Akzo Nobel: [Rediset WMX](#) >>>  
 All States Materials Group: [ECOBIT](#) >>>  
 Arkema Group: [CECABASE RT](#) >>>  
 Aspha-min: [Aspha-min Online](#) >>>  
 Astec Industries: [Double Barrel Green System](#) >>>  
 Gencor Industries: [Green Machine](#) >>>  
 Herman Warm Company: [Durobit Warm Mix System](#) >>>  
 Herculite: [Herculite](#) >>>  
 Inxam: [Inxam](#) >>>  
 Inomogy Technology: [Eco Emission System](#) >>>  
 MeadWestvaco Asphalt Innovations: [Ecotherm](#) >>>  
 Sasol Wax North America Corporation: [Sasobit](#) >>>  
 Shell: [Shell Thionax](#) >>>

“This listing does NOT constitute an endorsement or approval...”





# Warm-Mix Asphalt: Best Practices, 3<sup>rd</sup> Edition

- Technologies & Lab Foam Equip.
- Stockpile Moisture Management
- Burner Adjustments and Efficiency
- Aggregate Drying and Baghouse Temperatures
- Drum Slope and Flighting
- Combustion Air
- RAP usage
- Placement Changes

Quality Improvement Series 125



# 1<sup>st</sup> International Conference

- November 11-13, 2008 in Nashville, TN
  - Processes, Mix Production & Placement, Energy consumption, Mix Design, Material Properties

# 2<sup>nd</sup> International Conference

- October 11-13, 2011 in St. Louis, MO
  - Lab & Field Properties, Design & Performance, Health & Environment, RAP w/ WMA, Binder & Mix Properties, Moisture Susceptibility, Construction, etc.

Speaker Proceedings (MTG-WM2E) available @ <http://store.asphaltpavement.org>





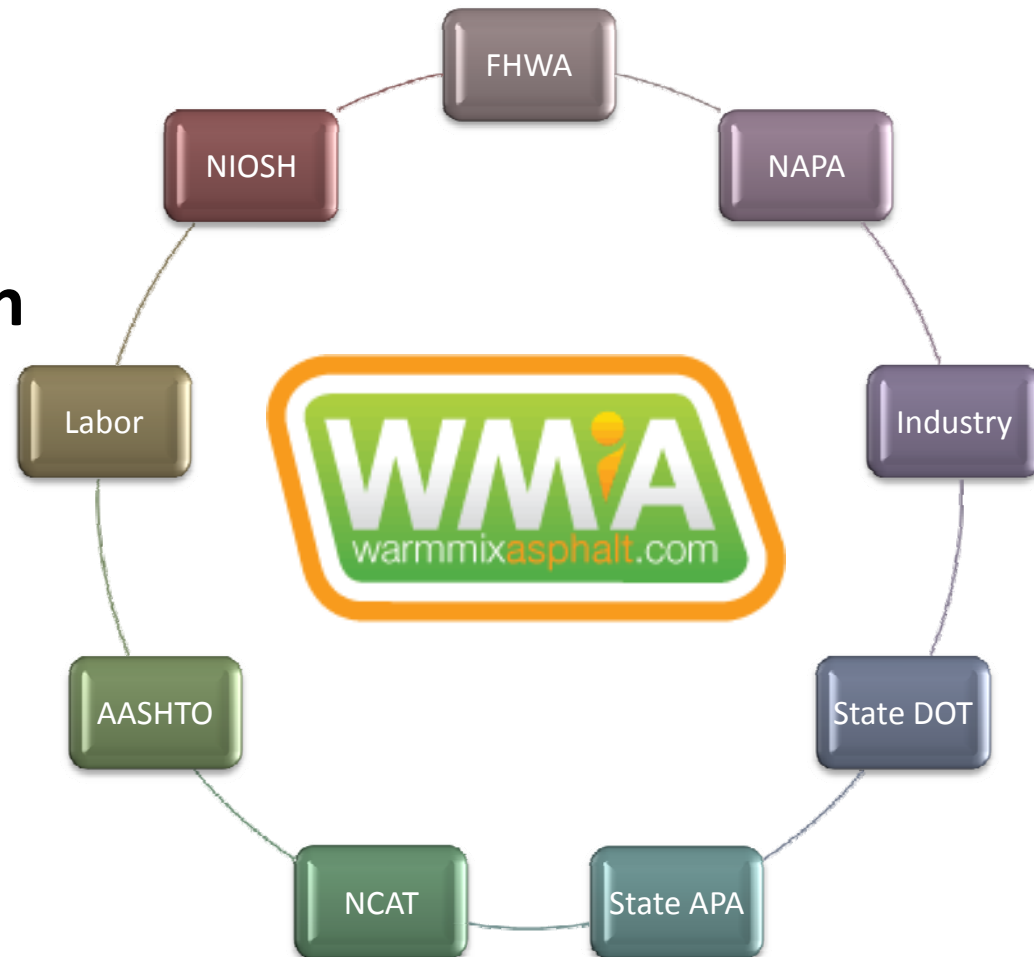
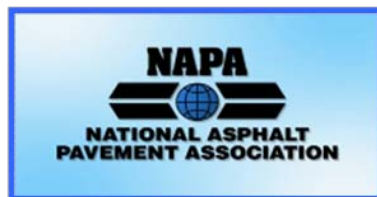
# Stakeholder Engagement: WMA Technical Working Group

Established 2005

**Co-Chairs:**  
**Matthew Corrigan**



**Ron White**





# National Research Initiatives

- NCHRP 9-43 “Mix Design Practices for Warm Mix Asphalt” \$500,000
- NCHRP 9-47A “Engineering Properties, Emissions, and Field Performance” \$900,000
- NCHRP 9-49 “Performance of WMA Technologies: Stage I - Moisture Susceptibility” \$450,000
- NCHRP 9-49A “Performance of WMA Technologies: Stage II - Long-Term Field Performance” \$900,000



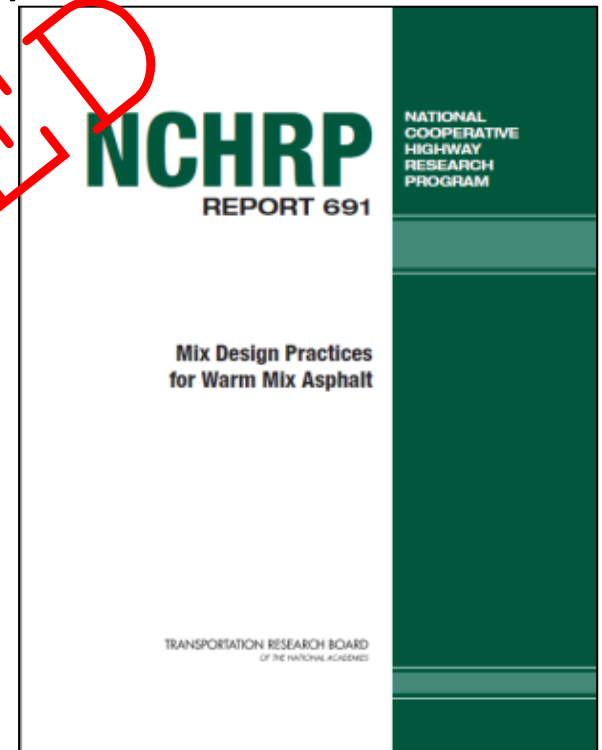


# National Research Initiatives

- NCHRP 9-43 “*Mix Design Practices for Warm Mix Asphalt*” \$522,501.00

**NCHRP Report 691**

**COMPLETED**



<http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=977>







# NCHRP Project 09-43

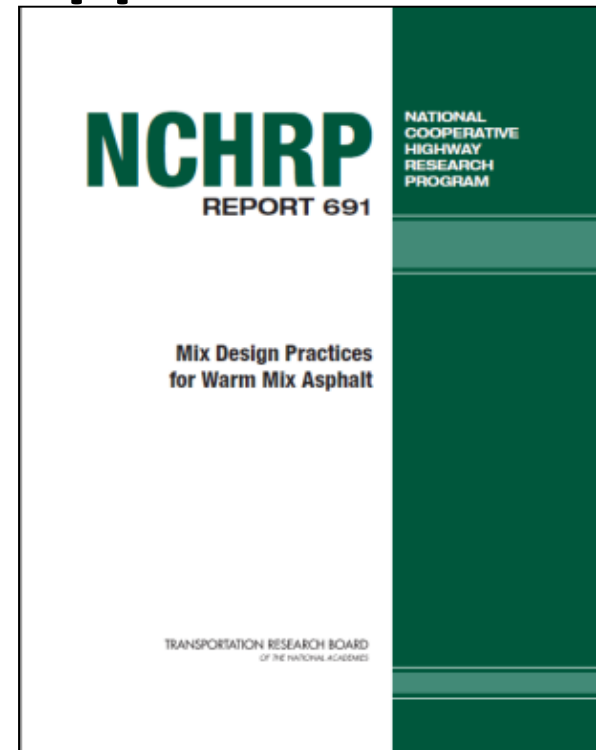
- Products:
  - Appendix to AASHTO R35 with commentary *“Special Mixture Design Considerations and Methods for Warm Mix Asphalt (WMA)”*
  - WMA Mix Design Workshop/Training Module
  - *“Standard Practice For Measuring Properties of Warm Mix Asphalt (WMA) for Performance Analysis Using the AASHTO MEPDG” (AASHTO Darwin ME Software)*
  - Chapter on WMA Mix Design for the NCHRP Project 09-33 Mix Design Manual





# National Research Initiatives

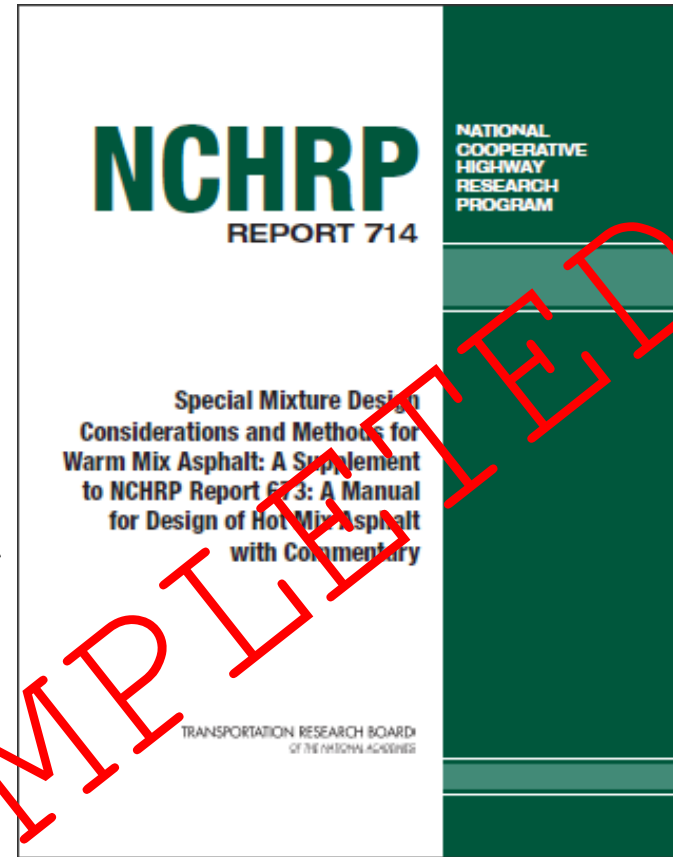
- NCHRP Report 691 “*Mix Design Practices for Warm Mix Asphalt*” – **Appendix D**
- “*Proposed Standard Practice for Measuring Properties of Warm Mix Asphalt (WMA) for Performance Analysis Using the Mechanistic-Empirical Pavement Design Guide Software*”





# National Research Initiatives

- NCHRP Report 714**  
*“Special Mixture Design Considerations and Methods for Warm-Mix Asphalt”*: A Supplement to NCHRP Report 673 “A Manual for Design of Hot-Mix Asphalt with Commentary” [NCHRP 9-33]



COMPLETED


[www.trb.org/main/blurbs/166517.aspx](http://www.trb.org/main/blurbs/166517.aspx)





[www.ct.gov/dot/AASHTO-R35](http://www.ct.gov/dot/AASHTO-R35)


A vertical strip of four images on the left side of the slide. From top to bottom: 1. A large piece of construction machinery, possibly a paver or spreader, on a construction site. 2. A white mobile office trailer with a red roof. 3. The interior of a construction site showing workers and equipment. 4. A close-up of a piece of machinery, possibly a sensor or control panel.

 **CONNECTICUT**  
**DEPARTMENT OF TRANSPORTATION**

 Video On-Demand

**Special Mixture Design  
Considerations and Methods for  
Warm Mix Asphalt (WMA)**

*An Appendix to AASHTO R35  
Standard Practice for Superpave  
Volumetric Design for Hot-Mix  
Asphalt (HMA)*



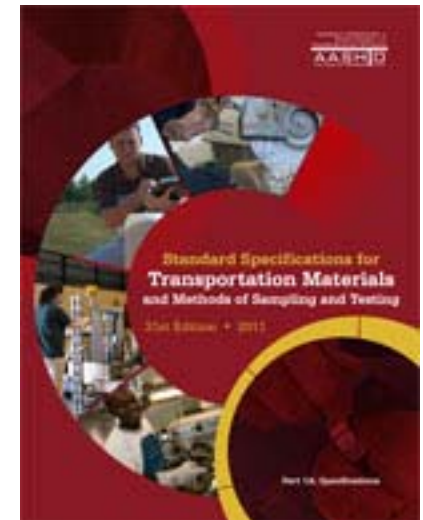
**Ramon Bonaquist, Ph.D., P.E.**

Special Mixture Design Considerations  
and Methods for WMA



Appendix to AASHTO R35 with commentary  
*“Special Mixture Design Considerations and  
Methods for Warm Mix Asphalt (WMA)”*

Approved by AASHTO Sub. on  
Materials and will be published  
in Standard Specifications for  
Transportation Materials and  
Methods of Sampling and  
Testing, 32nd Edition, 2012





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FHWA-NHI-131137

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## Course Description

Print Friendly Page

### *Special Mixture Design Considerations and Methods for Warm Mix Asphalt - WEB-BASED*

**PROGRAM AREA:** Pavements and Materials

**COURSE NUMBER:** FHWA-NHI-131137

CALENDAR YEAR	LENGTH	CEU	FEE
2011	2 Hours	0 Units	\$0 Per Participant
2012	2 Hours	0 Units	\$0 Per Participant

**TRAINING LEVEL:** Basic

**CLASS SIZE:** Minimum:1; Maximum:1

### DESCRIPTION:

Highway transportation agencies are exploring the use of warm mix asphalt (WMA) for pavement projects. One of their main questions, particularly for agency mixture design technicians and engineers, is how WMA design differs from hot mix asphalt (HMA) design. "Mixture Design for Warm Mix Asphalt" is a Web-based training that presents the modifications to the current Superpave volumetric design procedure, as described in AASHTO R35, that are needed to complete a WMA mixture design. The training highlights key differences in WMA and HMA design procedures, and provides an opportunity to apply the AASHTO R35 standard practice to a WMA design modification.

### OUTCOMES:

Upon completion of the course, participants will be able to:

### Search for a Course

enter keywords

more search options

### Connect with us



eSubscribe

Receive regular email updates

Tell Me More

### NHI Video

Introduction to NHI



Play Video



# National Research Initiatives

- WMA TWG Task Force 08-02 *“National Program for WMA Technologies”*
  - To utilize AASHTO National Transportation Product Evaluation Program (NTPEP)
- Resulted in... NCHRP 20-07 Task 311 *“Development of a Warm Mix Asphalt Technology Evaluation Program”*
  - ... to develop a standardized evaluation program compatible with AASHTO NTPEP’s centralized system of testing, evaluation, and data reporting of engineering materials for the state DOTs.





# National Research Initiatives

## Four TWG Proposed NCHRP projects for 2012:

- D-05 Develop an Approach for Lab Mix Short Term Aging That Correlates to Various HMA Plant Processing and Warm Mix Asphalts
- D-07 Short-Term Laboratory Conditioning of WMA Mixtures for Mix Design and Performance Testing
- D-08 Asphalt Foaming Characteristics for Warm Mix Asphalt Applications
- D-09 Laboratory Foaming and Mixing Processes for WMA Mix Design







# National Research Initiatives

Combined into two WMA NCHRP projects for 2012:

- NCHRP 9-52 “Short-Term Laboratory Conditioning of Asphalt Mixtures”  
\$800,000, 30 months
  - includes short-term laboratory conditioning of WMA mixtures for mix design and performance testing
- NCHRP 9-53 “Properties of Foamed Asphalt for Warm Mix Asphalt Applications”  
\$700,000, 27 months





# Commercially Available Laboratory Foaming Devices



PTi – THE FOAMER



Wirtgen, WLB 10 S



D&H Equipment – Hydro Foamer





# National Research Initiatives

Proposed WMA focused NCHRP project for 2013:

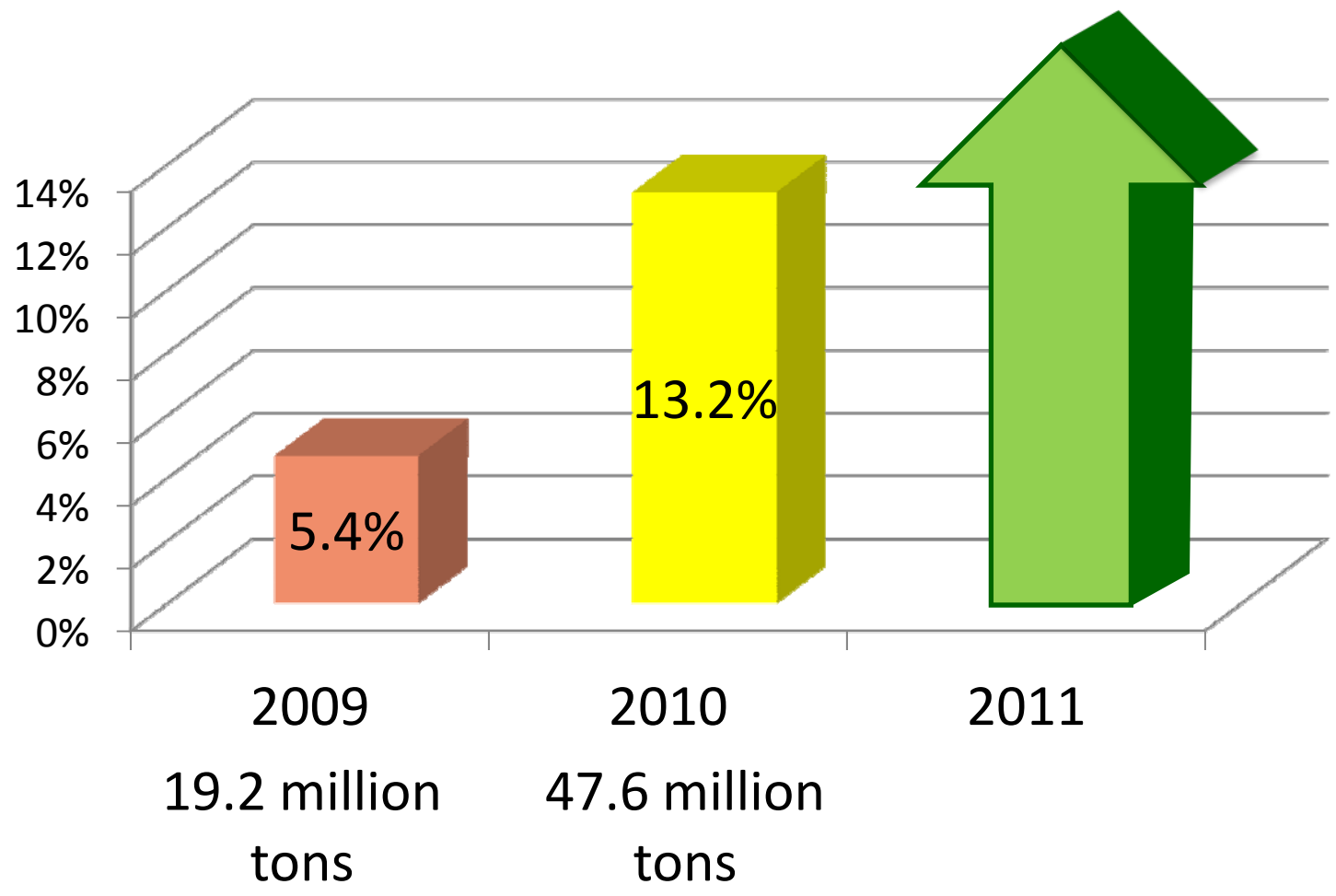
- “Recycled Asphalt Shingles (RAS) and Recycled Asphalt Pavement (RAP) in HMA/WMA Mixtures”
- Endorsement by:
  - AASHTO SOM TS2c *Asphalt-Aggregate Mixtures*
  - FHWA WMA Technical Working Group
  - FHWA RAP Expert Task Group
  - TRB Committee AFK10 *General Issues in Asphalt Technology*





# WMA Usage

Percentage of **Total** Asphalt Production in US  
source: National Asphalt Pavement Association

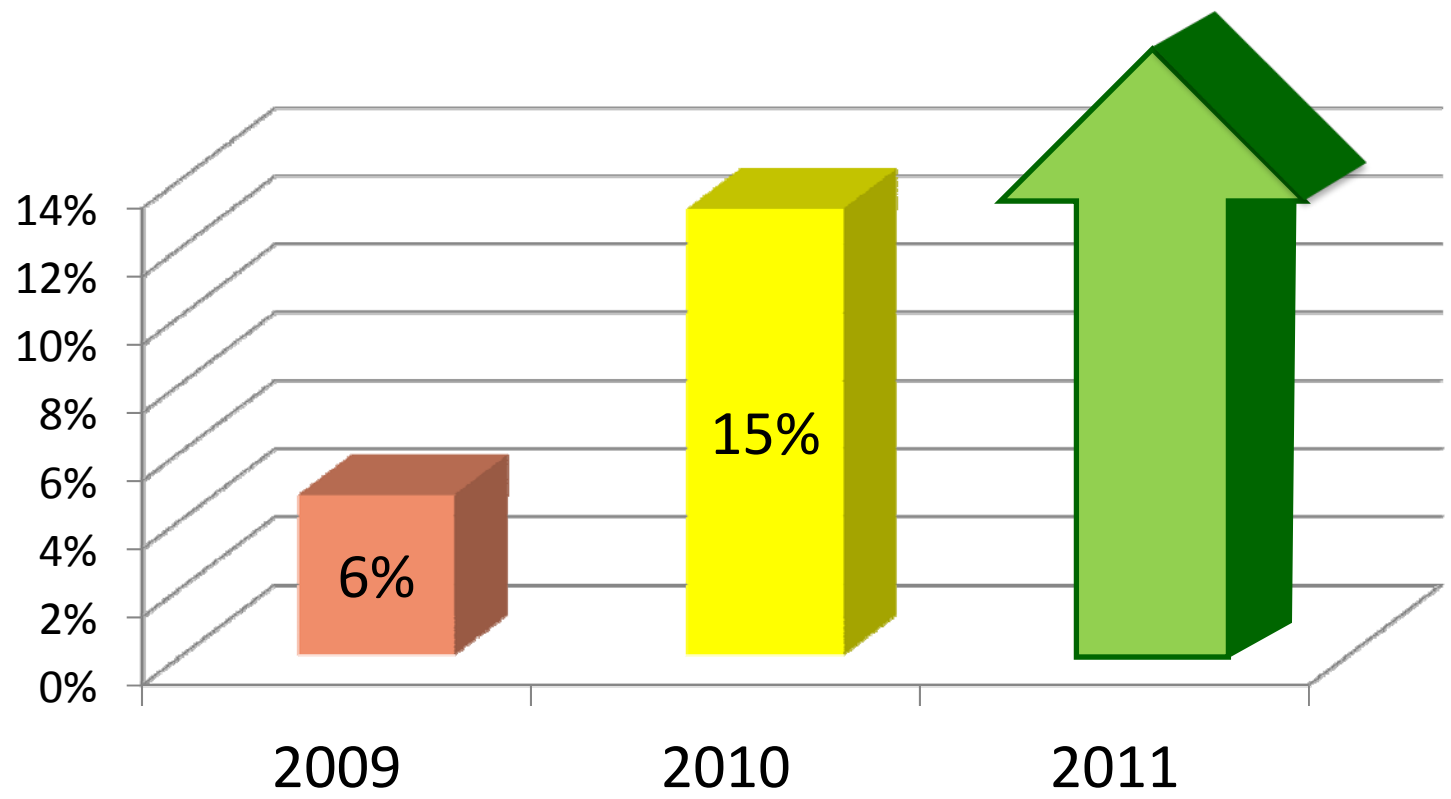




# WMA Usage

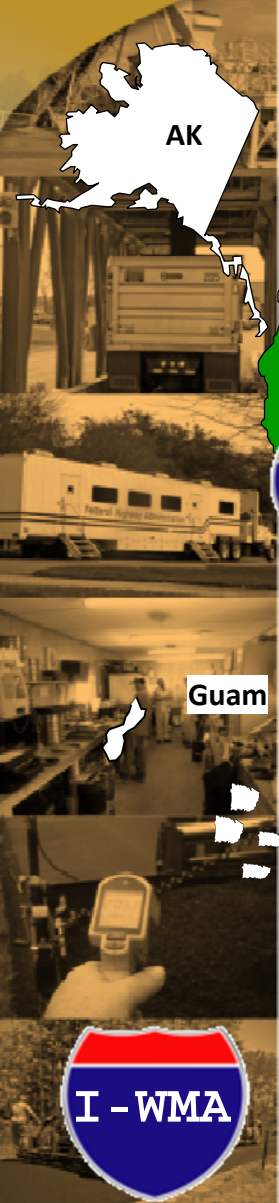
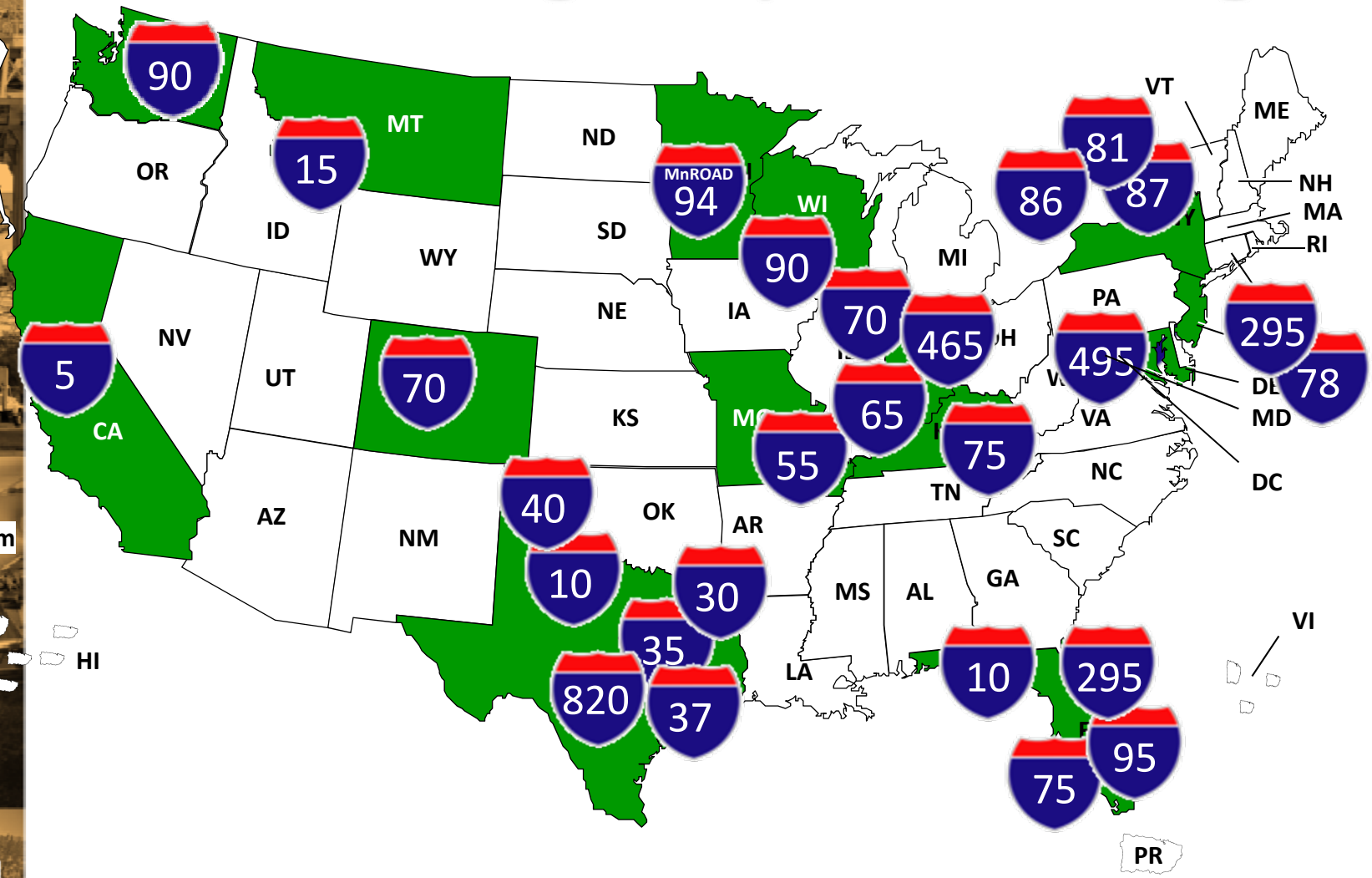
## Percentage of Asphalt Production for State DOTs

source: National Asphalt Pavement Association



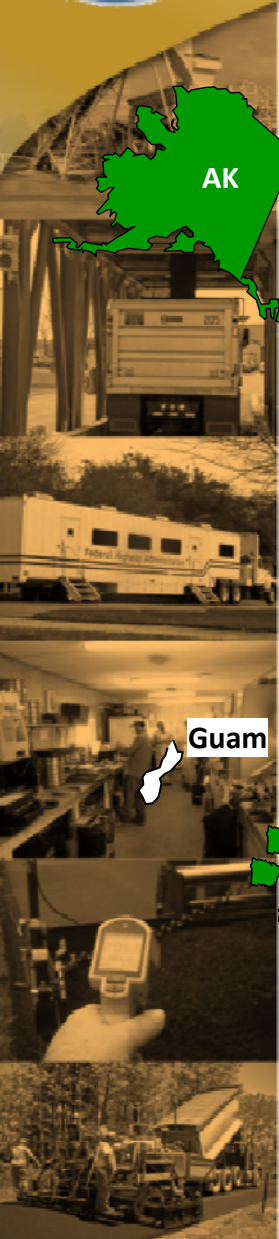
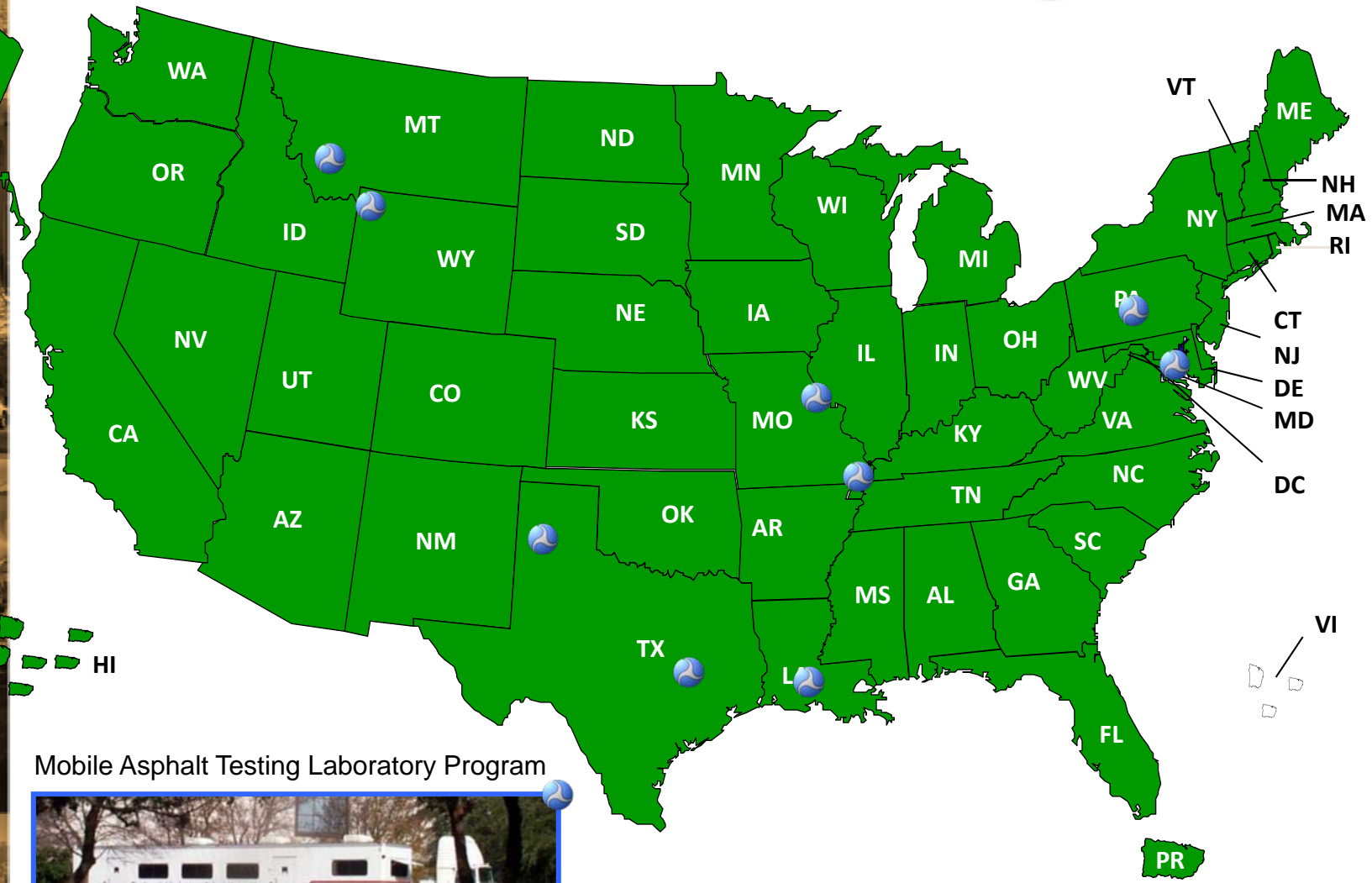


# Interstate Highway WMA Usage





# State DOT WMA Usage



Guam

Mobile Asphalt Testing Laboratory Program





# The Every Day Counts Initiative



INGENUITY IMAGINATION

INVENTION INNOVATION

## Accelerating Technology Deployment



Warm Mix Asphalt (WMA)



[www.fhwa.dot.gov/everydaycounts](http://www.fhwa.dot.gov/everydaycounts)







# EDC WMA Memorable Message

- **I.C. = I.P.**

Improved Compaction = Improved Performance

- **F.E.W. key benefits**

- Fuel
- Emissions
- Worker Comfort





# Performance Metrics



INGENUITY IMAGINATION

INVENTION INNOVATION

1. By December 2011, 40 State DOTs and all Federal Lands Divisions will have a specification &/or contractual language that allows WMA on Federal-aid or Federal Lands projects.
2. By December 2012, at least 30 State DOTs will have achieved set targets for WMA usage.





# The Givens

- WMA will continue to gain market share
- New innovations will occur
- Research will be challenged to keep up
- The demand for knowledge and training will grow
- Change is certain!!





# Where do we go from here?

- Implementation of standardized mixture design procedure (AASHTO R35 Appendix)
- Emphasize performance testing of WMA
  - Asphalt Mixture Performance Tester (AMPT)
    - Dynamic Modulus, Flow Number, Fatigue
  - Lab conditioning of WMA mixtures for mechanical testing





# Where do we go from here?

- Evaluation processes ... AASHTO NTPEP
  - Rigorous but not burdensome
    - Demonstrate successful projects
    - Document test results
    - Successful field trials
  - Not too time-consuming





# Where do we go from here?

- Research

- Short term performance is very promising
- Document long term performance
  - Fatigue and cold temperature properties
- WMA pavement ageing progression in the field
- Lubricating phenomenon within mixture
- Lab performance vs. field performance





# FHWA will...

- Continue to work in partnership
  - WMA TWG & other Asphalt ETG's
  - AASHTO Subcommittee on Materials
  - Asphalt User-Producer Groups
- Continue to provide technical support
  - Mobile Asphalt Testing Laboratory Program
  - HQ/Resource Center
- Continue to explore
  - Turner-Fairbank Highway Research Center







# FHWA will...

- Continue to support investigation, research, and training
  - Cooperative agreements with...
    - National Center for Asphalt Technology
    - Asphalt Institute
  - Focus on
    - Mixture design & performance testing
    - Binder ageing impacts
    - Production & lay-down
    - Forensics











Thank You!

**Matthew Corrigan, P.E.**  
Mobile Asphalt Laboratory Program Manager  
Warm Mix Asphalt Program Manager

ASPHALT

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