Warm Mix Asphalt in the United States: From Evolution to Revolution

Matthew Corrigan, P.E.

Asphalt Pavement Engineer

Mobile Asphalt Testing Trailer Technical Manager

U.S. DOT – Federal Highway Administration

November 19, 2014

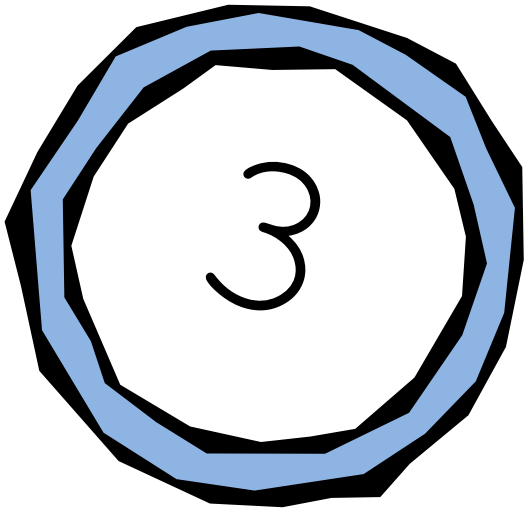
U.S. Department of Transportation
Federal Highway Administration

Pavements / Materials Conference

Where have we been?

2004-05

Number of named WMA technologies in the U.S.?



2013-14

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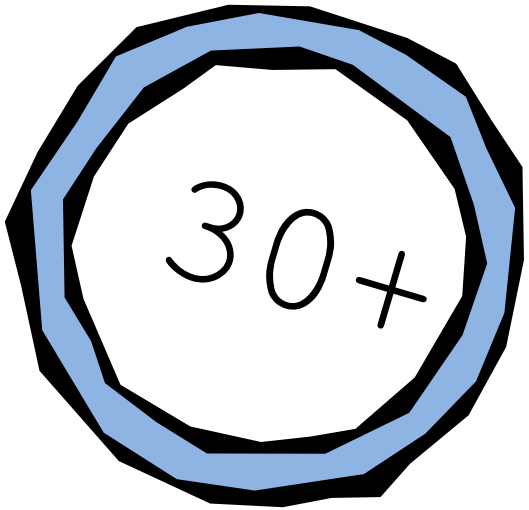
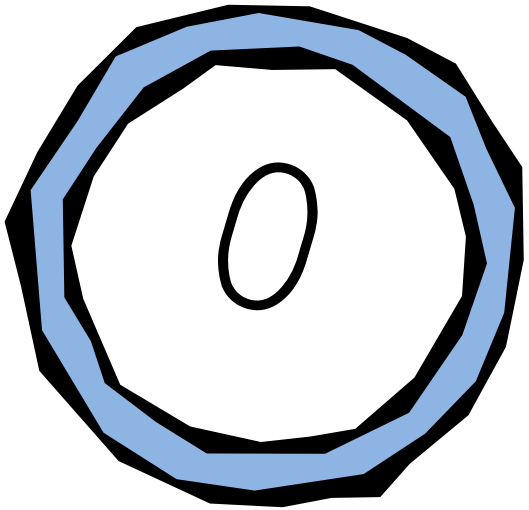


Where have we been?

2004-05

No. of WMA Technical Working Groups?



2013-14

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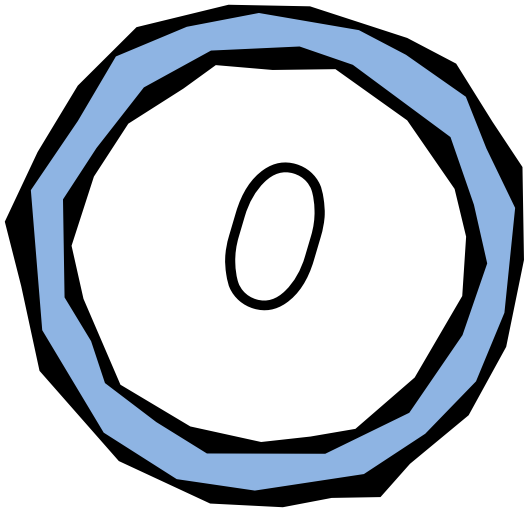


Stakeholder Engagement: WMA Technical Working Group

Established in 2005
Adjourned in 2012

Co-Chairs:
Matthew Corrigan

U.S. Department of Transportation Federal Highway Administration

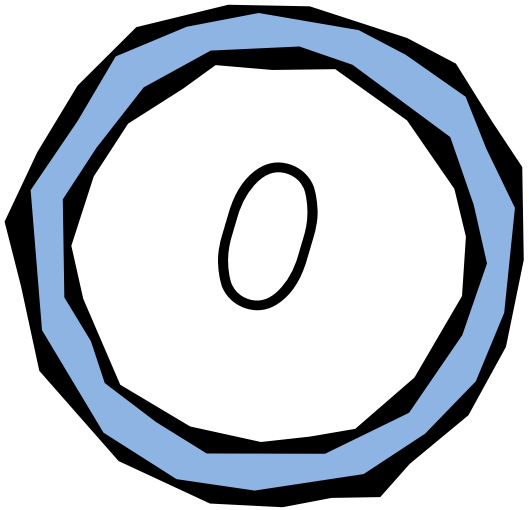
Ron White

NAPA NATIONAL ASPHALT PAVEMENT ASSOCIATION

Where have we been?

2004-05

No. of WMA International Conferences?



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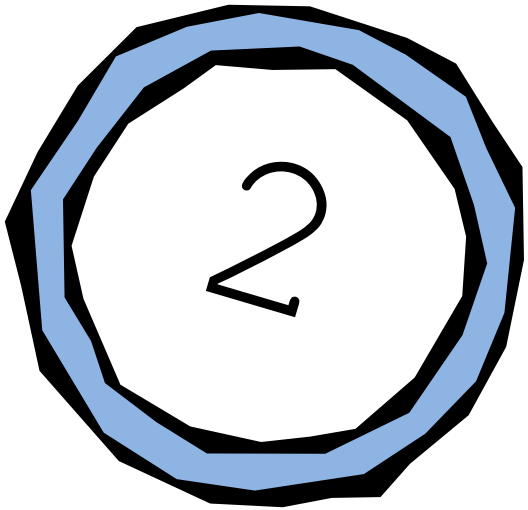


International WMA Conferences

1st Conference on November 11-13, 2008 in Nashville, TN

Processes, Mix Production & Placement, Energy consumption, Mix Design, Material Properties

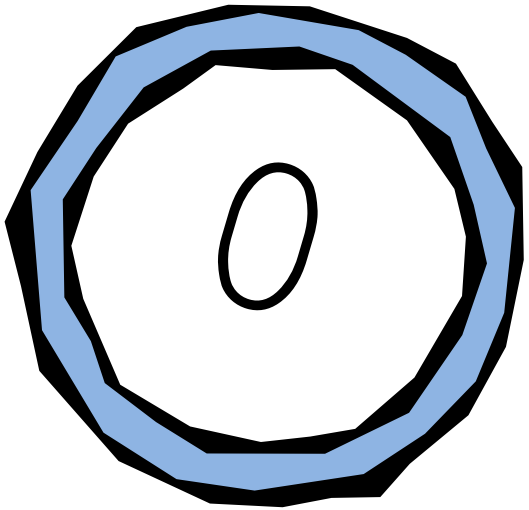
2nd Conference October 11-13, 2011 in St. Louis, MO

Lab & Field Properties, Design & Performance, Health & Environment, RAP w/ WMA, Binder & Mix Properties, Moisture Susceptibility, Construction, etc.

Where have we been?

2004-05

Number of WMA NCHRP Research Projects?



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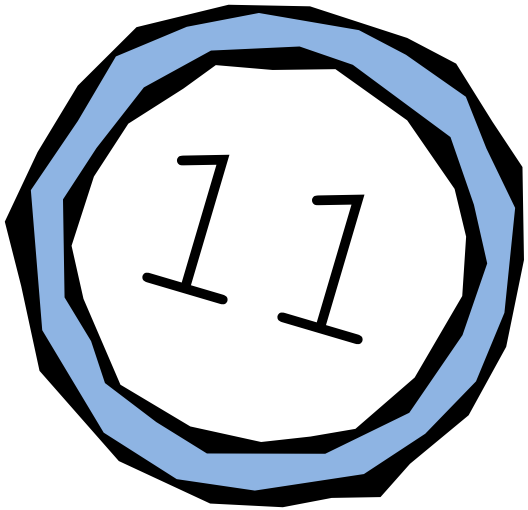

NCHRP Projects funded as a result of WMA TWG efforts:

9-43	-Mix Design Practices for WMA	$522,501	completed
9-47	-Engineering Properties, Emissions, and Field Performance of WMA Technologies	$79,000	completed
9-47A	-Properties and Performance of WMA Technologies	$1,121,000	completed
9-49	-Performance of WMA Technologies: Stage I--Moisture Susceptibility	$450,000	completed
9-49A	-Performance of WMA Technologies: Stage II--Long-Term Field Performance	$900,000	Jul 2016
9-52	-Short-Term Laboratory Conditioning of Asphalt Mixtures	$800,000	Nov 2014
9-53	-Properties of Foamed Asphalt for Warm Mix Asphalt Applications	$700,000	Dec 2014
9-54	-Long-Term Aging of Asphalt Mixtures for Performance Testing and Prediction	$800,000	May 2016
9-55	-Recycled Asphalt Shingles in Asphalt Mixtures with WMA Technologies	$600,000	Sept 2016
9-58	-Effects of Recycling Agents on Asphalt Mixtures w/High RAS & RAP Binder Ratios	$1,500,000	July 2017 est.
20-07 (311)	-Development of a WMA Tech. Evaluation Program	$50,000	completed

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Total $7,522,501

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
  - Chapter on WMA Mix Design for the NCHRP Project 09-33 Mix Design Manual
  - *"Standard Practice For Measuring Properties of Warm Mix Asphalt (WMA) for Performance Analysis Using the AASHTO MEPDG" (AASHTO DARWin-ME™ Software)*

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

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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:

Expansion of NCHRP 9-43 Mix Design Study to Higher Absorption Mixtures

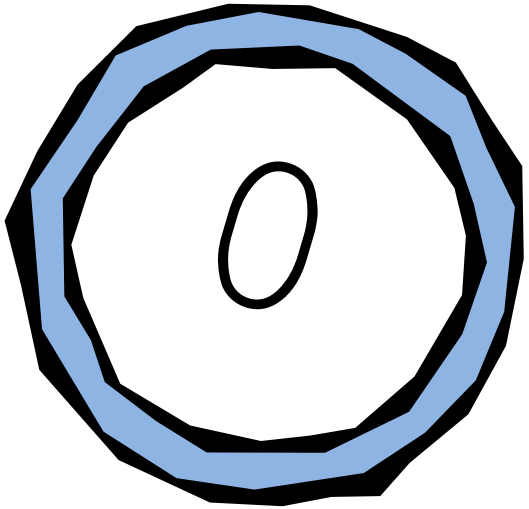
- Original Project 9-43
  - Binder Absorption limited to 0.5 - 1.0 %
- ETG Work Item: Expansion to Higher Absorption Mixtures ≥ 2.0%
  - Includes High Absorption Lab Foamed Mix
- Completed by Dr. Ray Bonaquist, AAT
- Confirmed impact of WMA on mixture volumetrics and performance during design and AASHTO R 35 WMA Appendix

- NCHRP 20-07/ Task 311, **Development of a Warm Mix Asphalt Technology Evaluation Program**
  - Myers McCarthy Consulting Engineers, LLC
  - http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3075
- AASHTO NTPEP Program for evaluating WMA technologies is in development www.ntpep.org

Where have we been?

2004-05

Number of WMA Best Practices Publications?



2013-14

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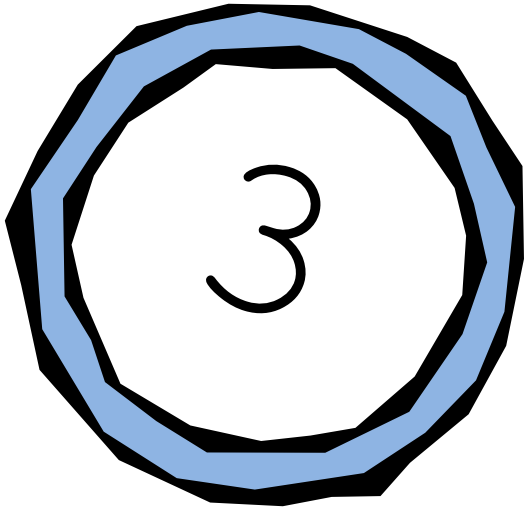

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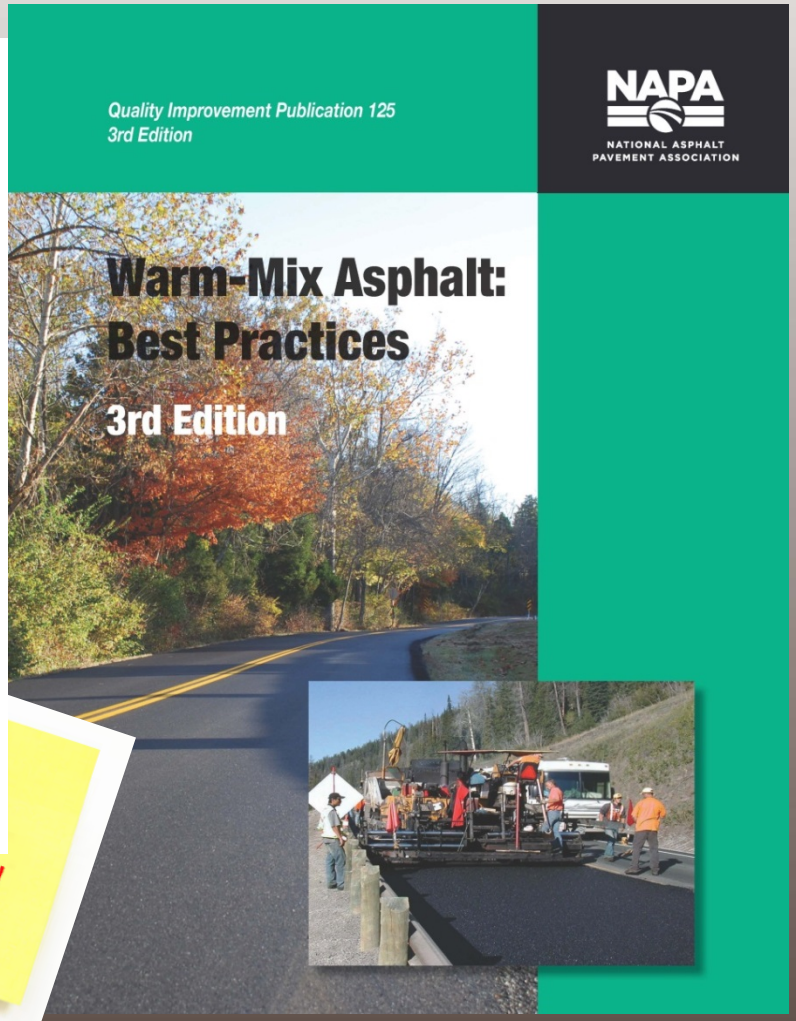
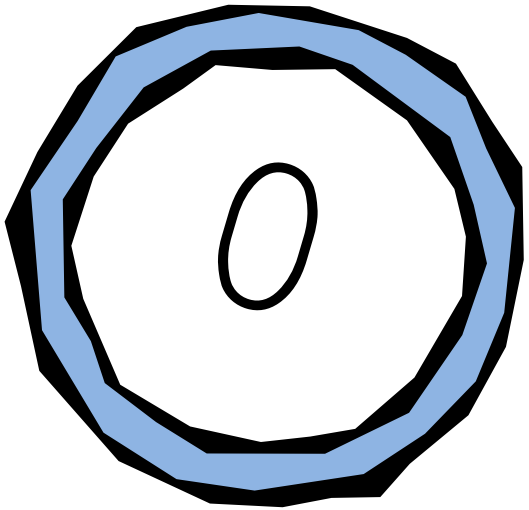


Where have we been?

2004-05

Number of AASHTO Standards on WMA?



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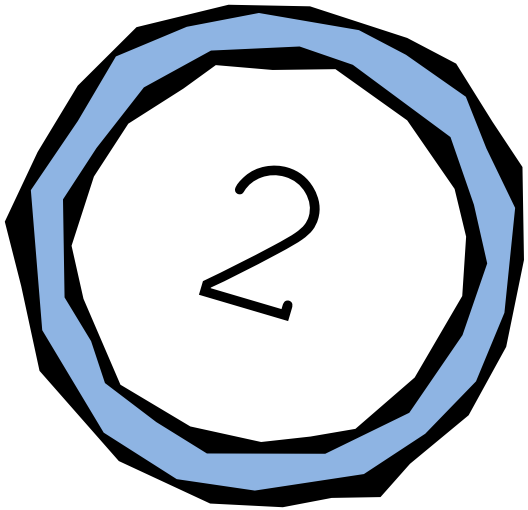

Appendix to AASHTO R35 with commentary "Special Mixture Design Considerations and Methods for WMA"

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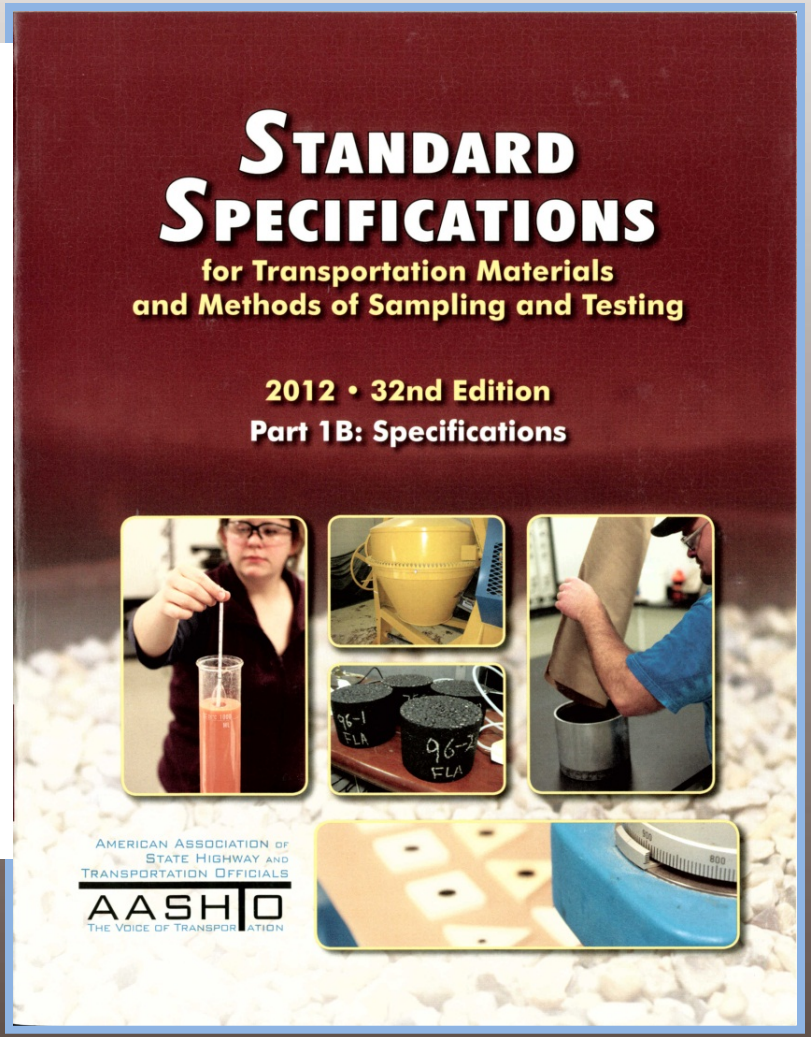

U.S. Department of Transportation
Federal Highway Administration

AMPT Flow Number standardization

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X1. EVALUATE RUTTING RESISTANCE USING THE FLOW NUMBER TEST

X1.1 *Scope:*

X1.1.1 This procedure establishes a method to evaluate the rutting resistance of asphalt paving mixtures
test in the AMPT.

n Table X1.2.1.1to the AMPT control software for the Flow

ber Test Conditions

HMA	WMA
1-	*1-*
87 psi (600 kPa)	87 psi (600 kPa)
5% of deviator stress	5% of deviator stress
0 psi (0 kPa)	0 psi (0 kPa)

n temperature using LTPPBind version 3.1; computed using 50%
ı for surface courses and the top of the pavement layer for
es.

each specimen, and average the results. Compare the average
Table X1.2.2.

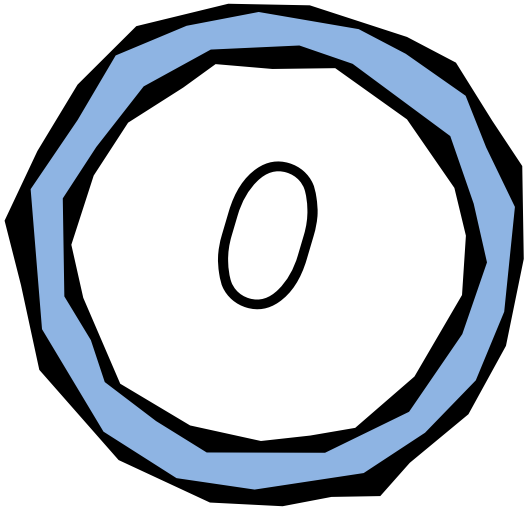
lumber Requirements

Traffic Level, million ESAL's	HMA, minimum Flow Number	WMA, minimum Flow Number
< 3	---	---
3 to < 10	50	30
10 to < 30	190	105
> 30	740	415

Where have we been?

2004-05

Number of WMA tons produced annually?



2013

Number of WMA tons produced annually?

Information Series 138

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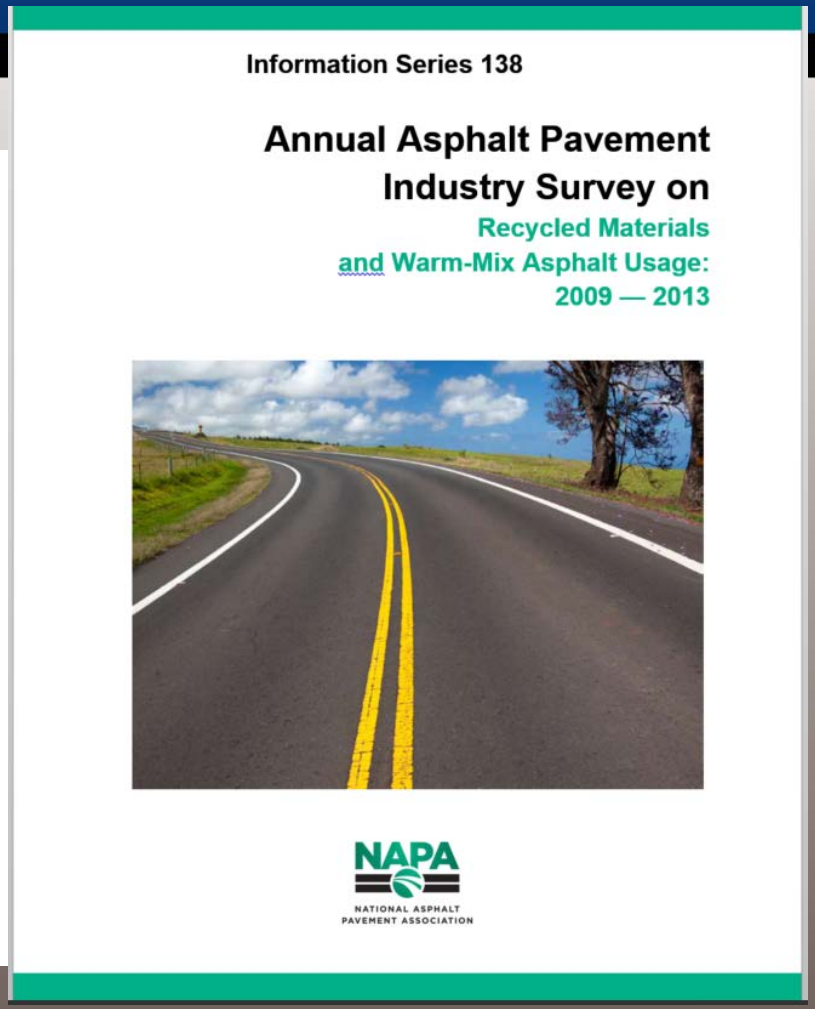
Product of FHWA & NAPA Cooperative Agreement Contract



www.asphaltpavement.org/recycling

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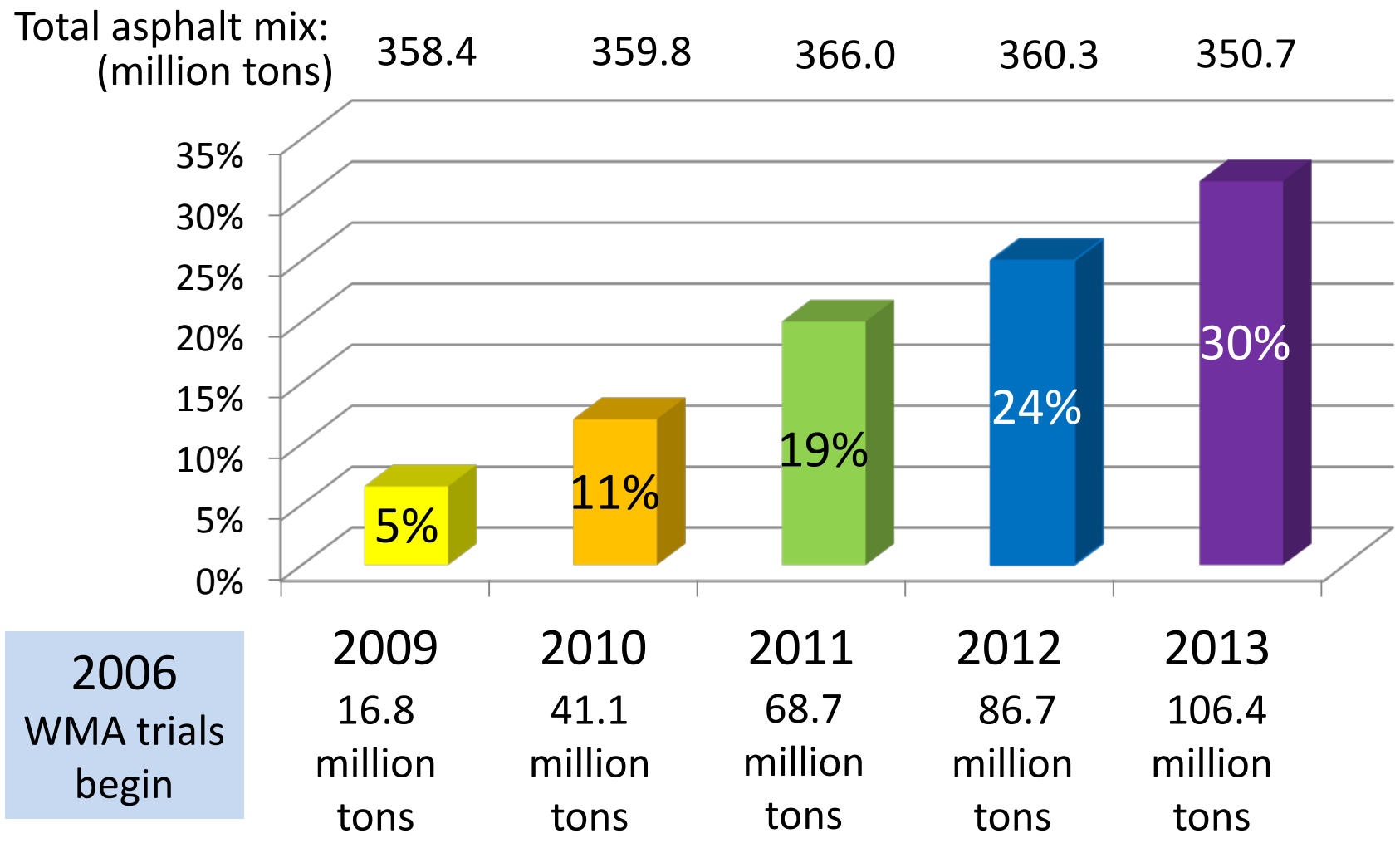
WMA Usage in HMA/WMA

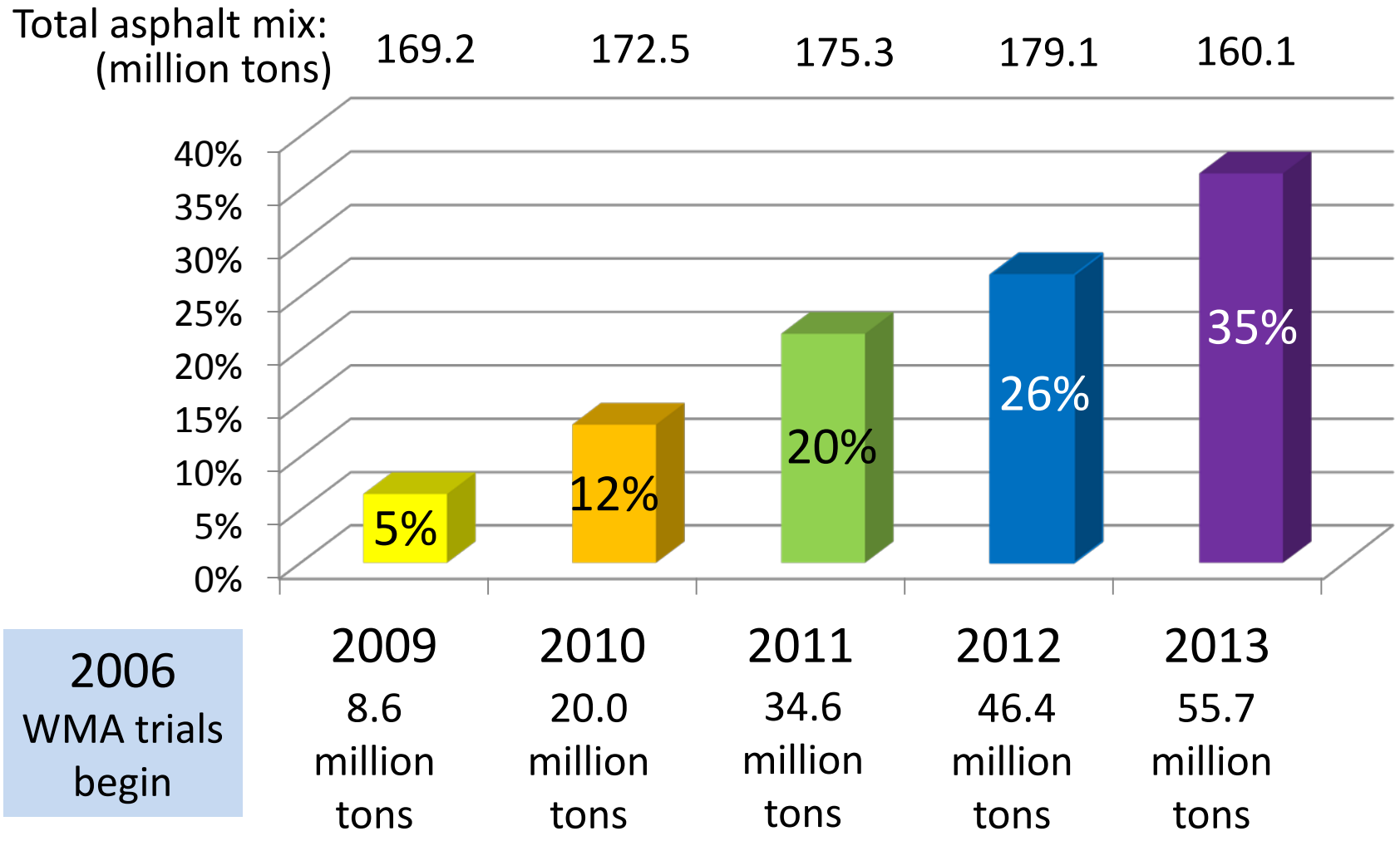
*Percentage of **Total** Mix Production in USA*



2006
WMA trials begin

StateDOT WMA Usage in HMA/WMA

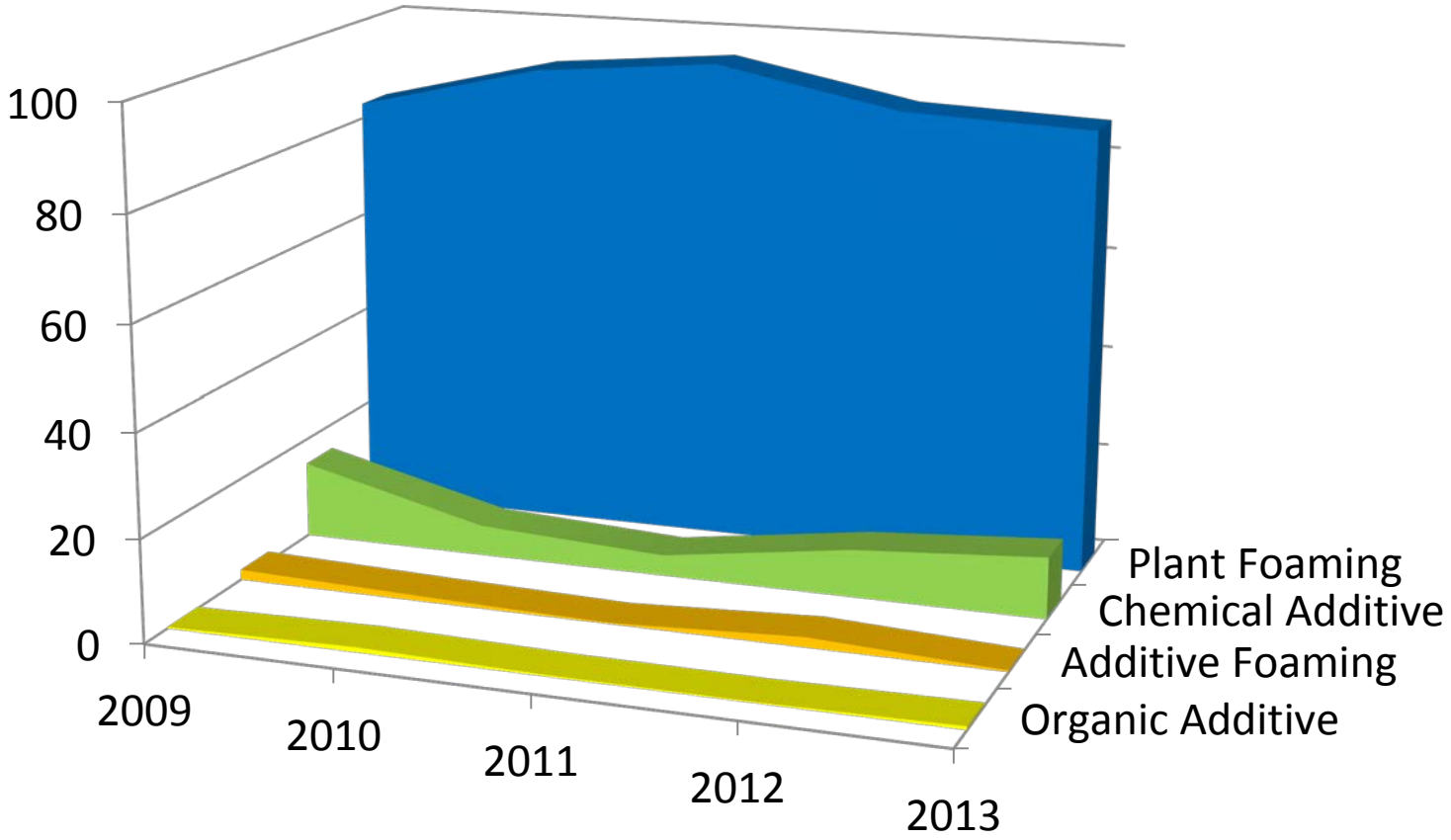
*Percentage of **State** Mix Production in USA*



2006
WMA trials begin

WMA Usage by Technology

Percent *of market for WMA production in USA*



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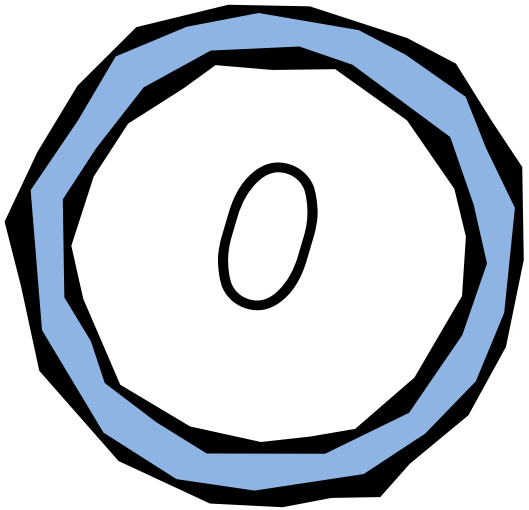
Number of WMA projects evaluated by FHWA?



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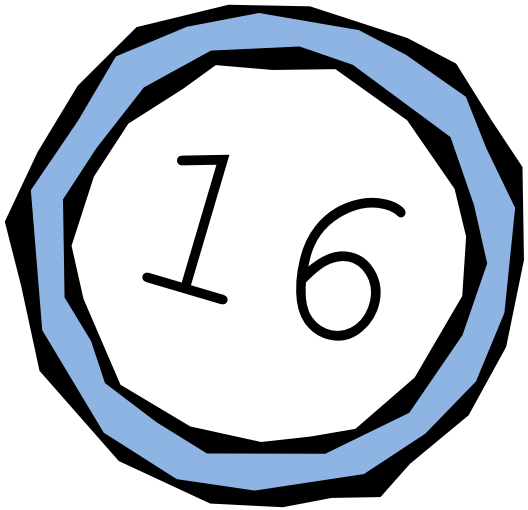
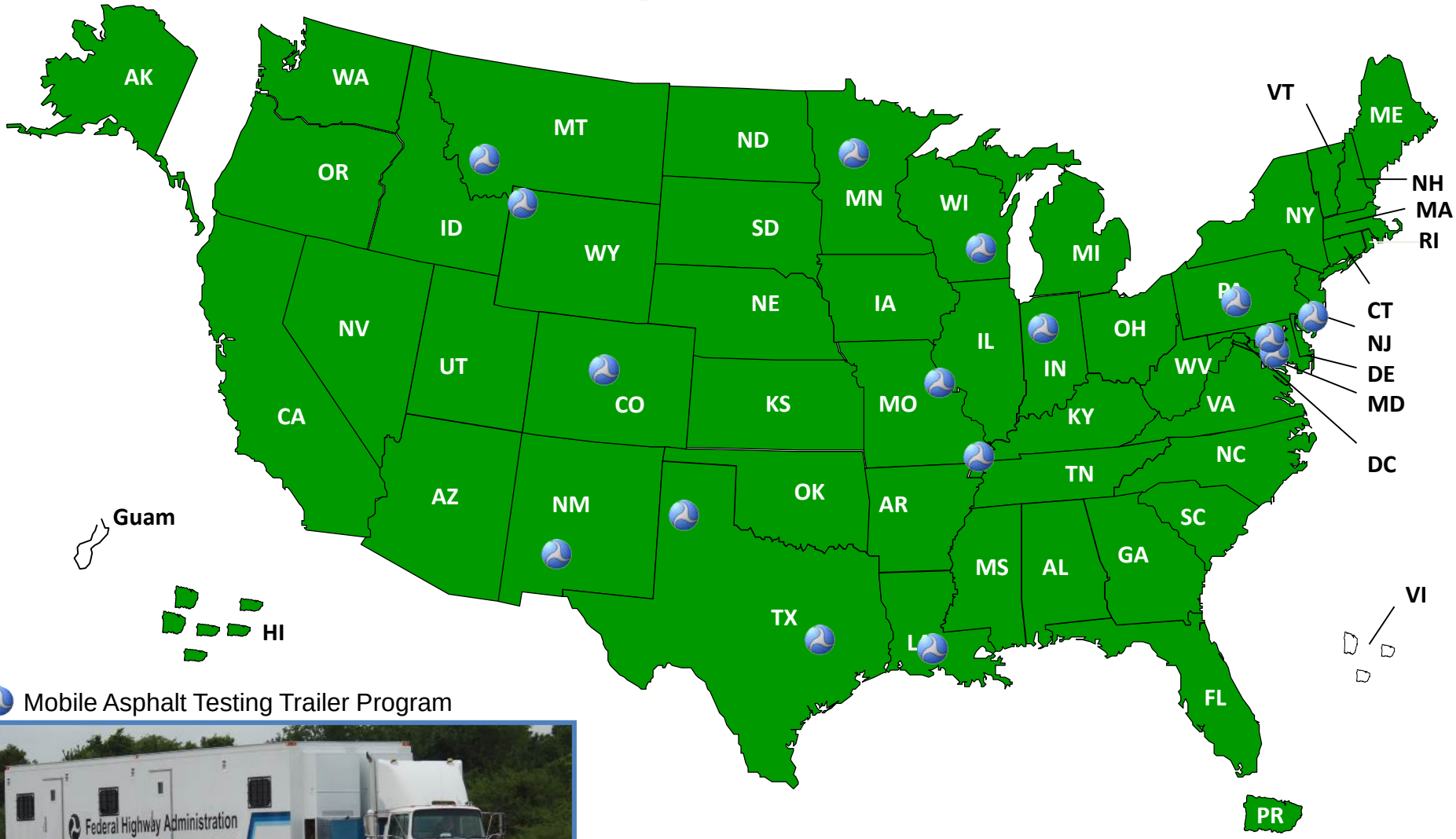


FHWA Field Support
Mobile Asphalt Testing Trailer (MATT)

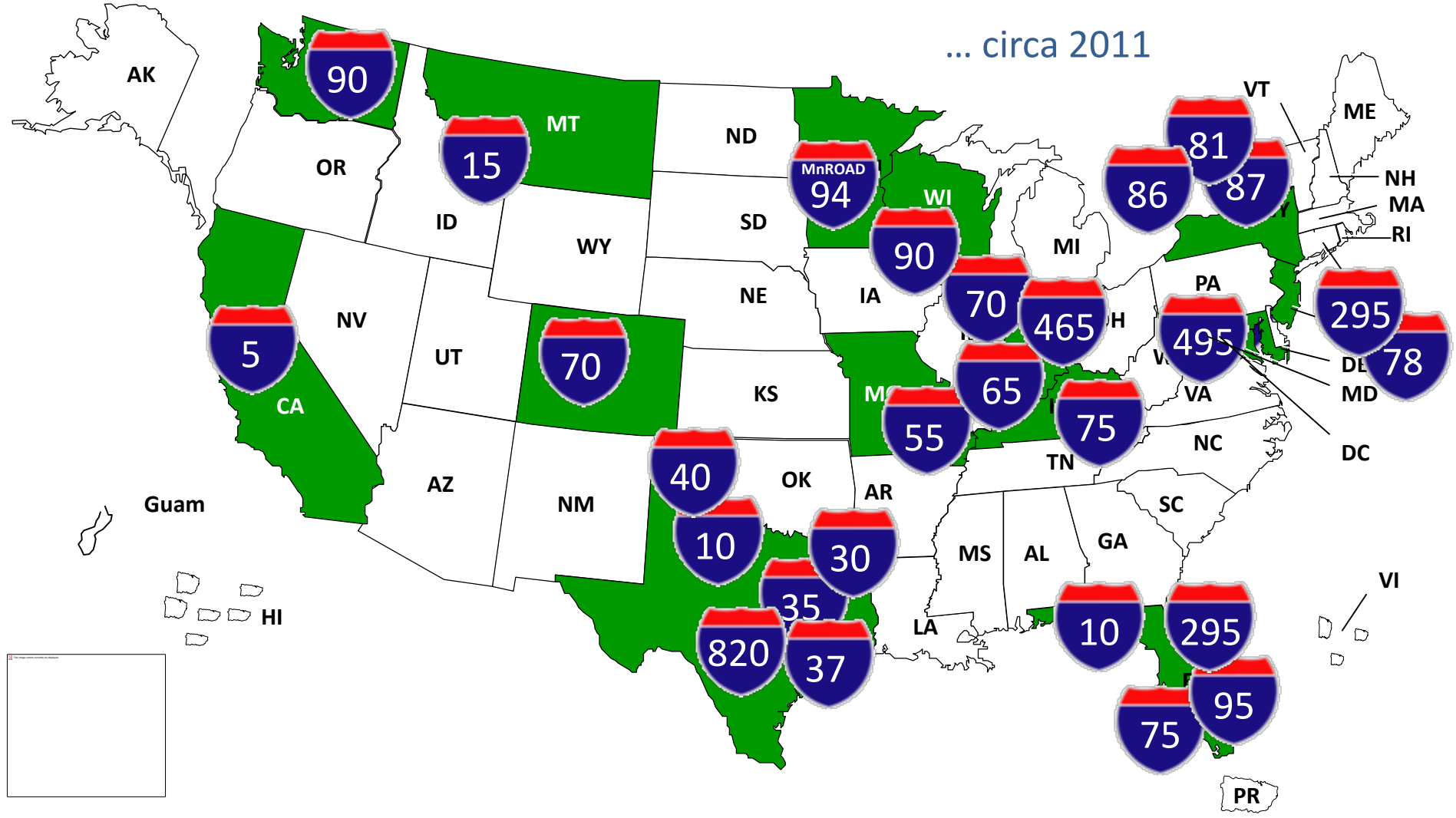
- Mobile Asphalt Pavement Materials Lab
  - Site Visit
  - Field Data/Testing
  - Use/Demo Emerging Test Devices
  - POC: Matthew Corrigan, P.E.

WMA Project Locations



Mobile Asphalt Testing Trailer Program

Interstate Highway WMA Usage



U.S. Department of Transportation Federal Highway Administration

"The collective efforts from highway agencies and industry partners to advance warm mix asphalt technologies as a standard practice has been tremendous."

- U.S. DOT Federal Highway Administration

"[We] support the development and implementation of warm-mix asphalt … this will inevitably become the standard practice for asphalt mixture production."

- Global Asphalt Pavement Alliance

Global Asphalt Pavement Alliance

NAPA NATIONAL ASPHALT PAVEMENT ASSOCIATION

"WMA is the future of flexible pavements in the U.S. … lowering our production and paving temperatures promises improved energy consumption, operations, and quality."

-Mike Acott, President, NAPA

"WMA technology provides an important tool to the pavement engineer … designers and contractors alike now have a great opportunity to learn more about this promising practice which is revolutionizing the paving industry in North America."

asphalt institute

-Pete Grass, President, Asphalt Institute

232.03806
90 Thank
2-8-18-32-18-10-2

88.90585
39 You
2-8-18-9-2

Discussion / Comments / Questions

FHWA's Mobile Asphalt Testing Trailer
Office of Asset Management, Pavement, and Construction

U.S. Department of Transportation
Federal Highway Administration