Warm Mix Asphalt

The Future of Flexible Pavements

Northeast Pavement Preservation Partnership

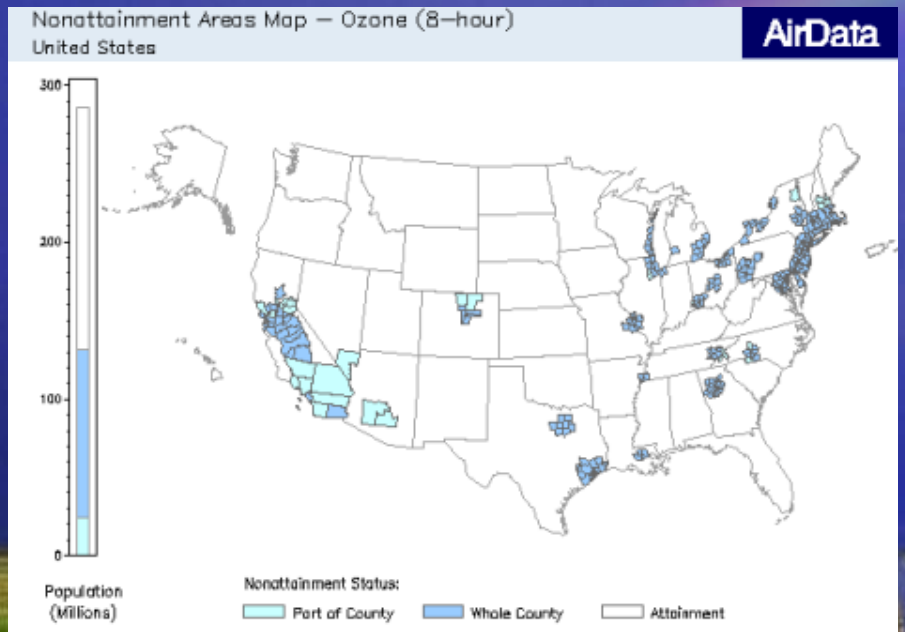
November 8-10, 2010

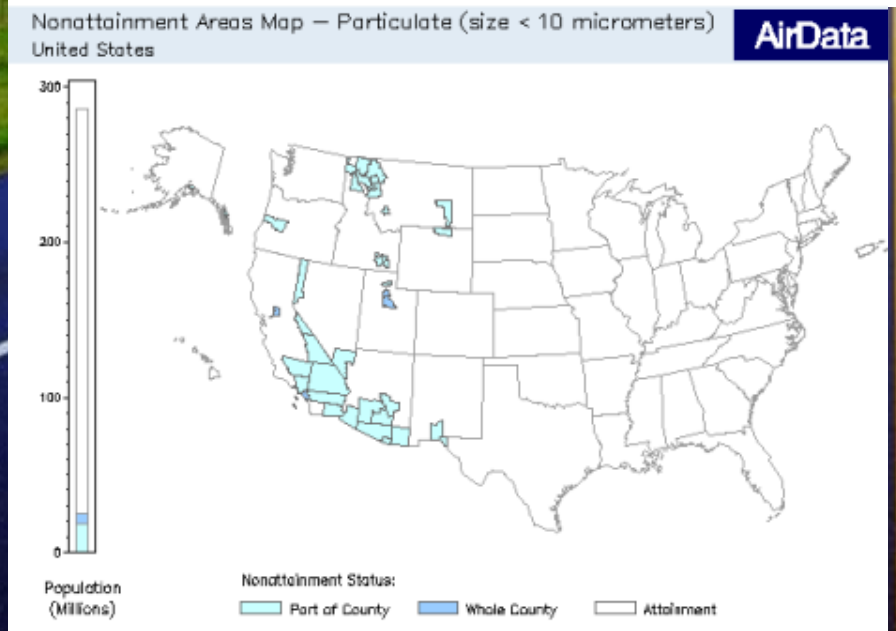
NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION

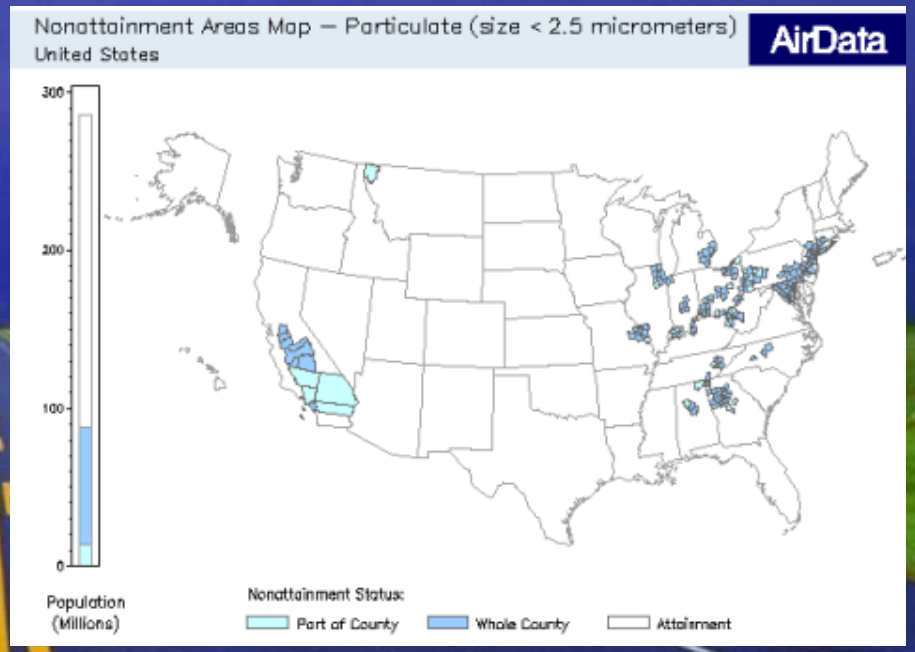
General Trends

- Regulations
- Activism
- Higher Production Temperatures
- Increasing Energy Costs

Current (2008)Non-Attainment Areas







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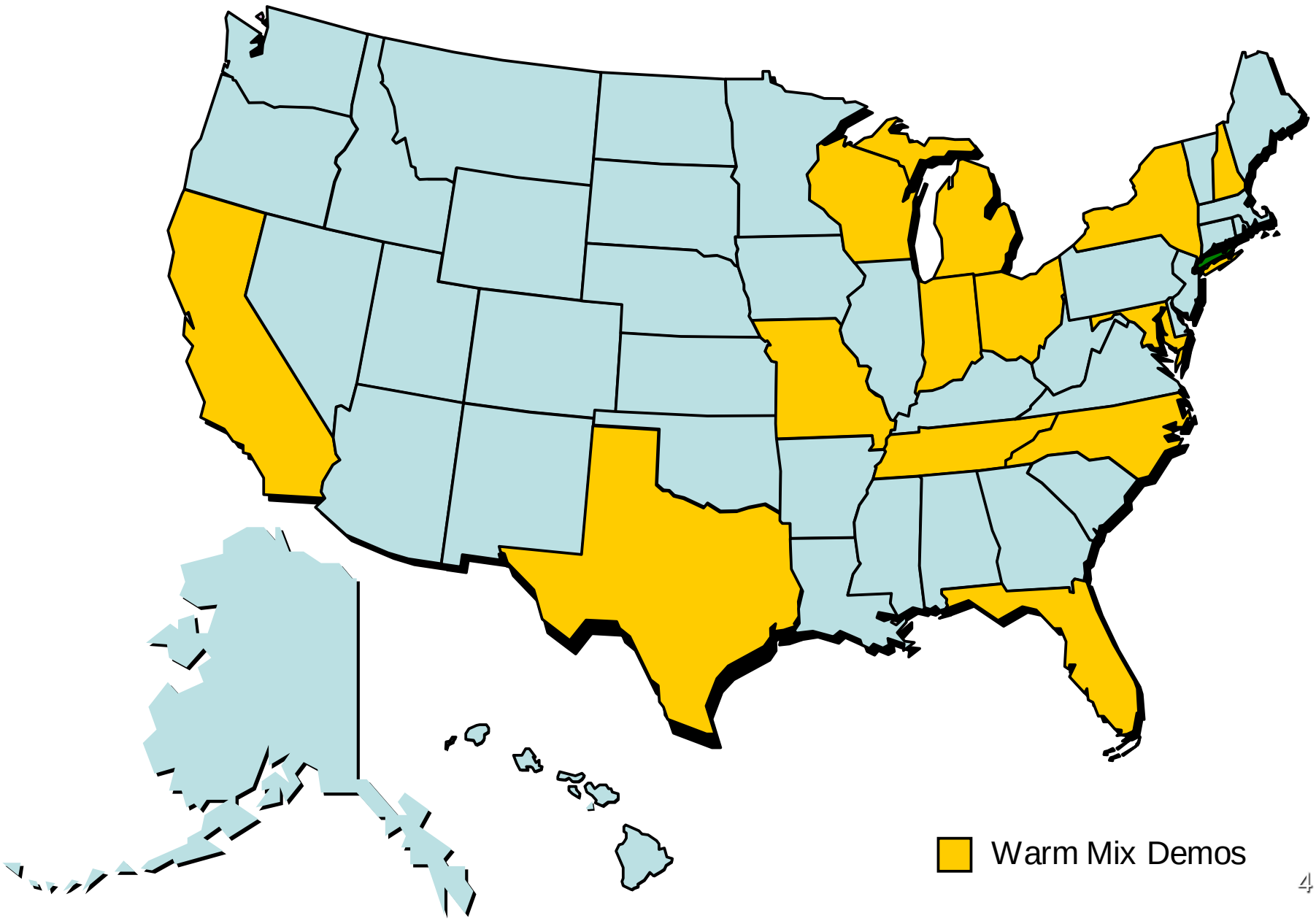
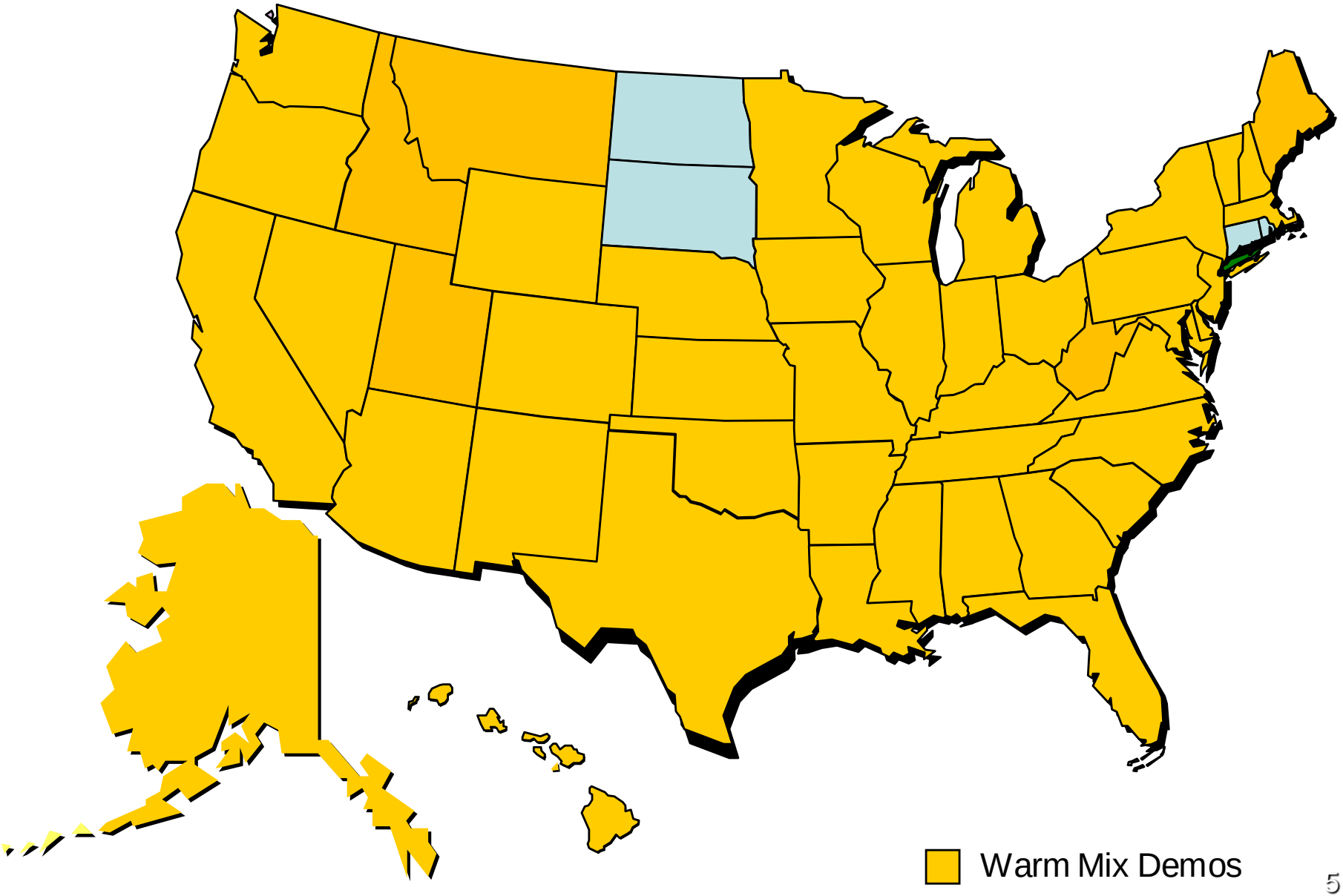
Warm Mix Demonstration Projects in the U.S. as of Jan. 2007



Warm Mix Demonstration Projects in the U.S.



Brief History

1997 German Bitumen Forum
2000 Second Euroasphalt & Eurobitume Congress (Barcelona)
NAPA 2002 European Scan Tour
– Germany and Norway
NAPA 2003-2008 Annual Meetings
World of Asphalt 2004
2005-2007 – Numerous U.S. Field Trials
2007 – FHWA/AASHTO Scan Tour
2008 – Permissive Specifications

Potential Advantages of Lower Temperatures

- Lower fumes and emissions (~30-90%)
- Lower energy consumption (~30%)
- Lower plant wear
- Decreased binder aging
- Early site opening
- Cool weather paving
- Compaction aid for stiff mixes
- Cooler working conditions

Warm Mix Asphalt Technical Working Group

- Members: FHWA, NAPA, SAPA, AASHTO, State DOTs, NCAT, Contractors, Labor, NIOSH
- Mission: Evaluate and validate WMA and share information
- Purpose: Guidance for research and implementation of WMA

Technology Overview**

- WAM-Foam
- Low Emission Asphalt
- Aspha-Min
- Advera
- Sasobit
- REVIX
- Evotherm
- Cecabase RT
- Thiopave
- Rediset WMX
- AquaFoam
- Ultrafoam GX
- Terex
- Accu•Shear
- Aquablack
- Double Barrel Green

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

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

Others** …

Trinidad Lake Asphalt (TLA)

Astec Green Pac

AESCO/Madsen Eco-Foam II

Sonneborn AdRap

Herman Grant

More to come …

Many technologies also used Internationally

Applications

- Dense-graded mixes
  - Majority of projects
  - RAP – Wisconsin and Missouri
- SMA
  - Maryland – Washington Beltway
- Open-graded mixes
  - Florida
  - China
- Asphalt-Rubber
  - California

Plant Foaming Techniques

- Small amount of moisture introduced to binder ahead of mixing
  - Steam causes volume expansion
  - Expansion allows for coating at lower temperatures

Material Foaming Processes

- Use water-bearing zeolite which releases moisture at high temperatures.
- Use a carefully controlled amount of moisture in sand added to hot coarse aggregate and asphalt.

Additives

- Long-chain paraffin
  - Viscosity reduced at high temperatures
  - Harden at service temperatures
- Surfactant based
  - Reduce surface tension of binder
  - Coating at lower temperatures

Chattanooga - Loadout

Yellowstone Paving

Production and Paving Notes

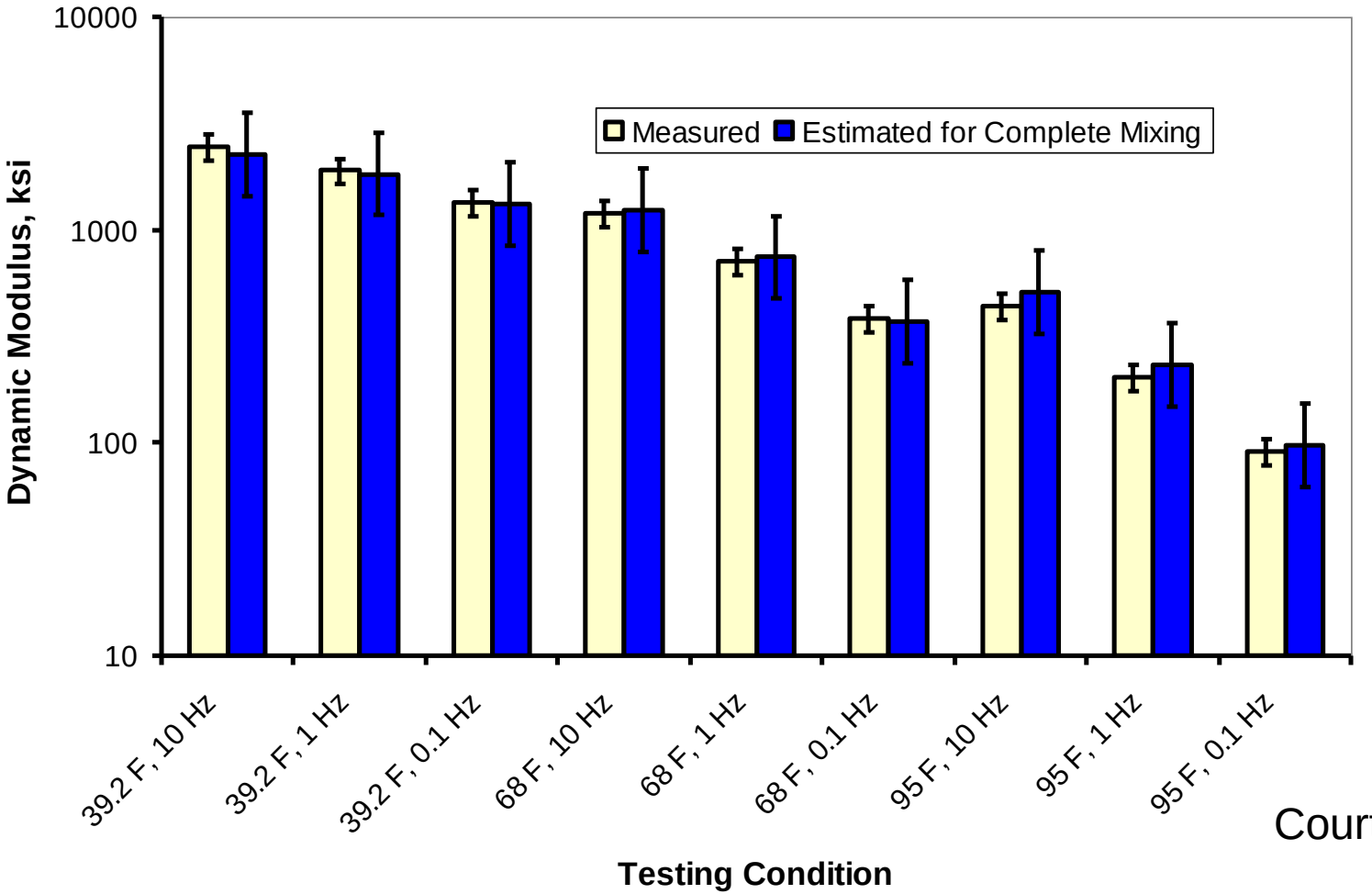
- Work to minimize aggregate moisture.
- Make sure the burner is tuned for the temperature.
- Keep baghouse temperature above condensation point.
- Consider superheating aggregate ahead of RAP.
- Follow normal placement practices.

RAP and WMA

- Will RAP and New Binders Mix at WMA Process Temperatures?
- Interfacial Mixing Study
  - Atomic Force Microscope
- Lab Mixing Studies
  - Dynamic Modulus Evaluation

Courtesy AAT

NCHRP 9-43 - Sasobit



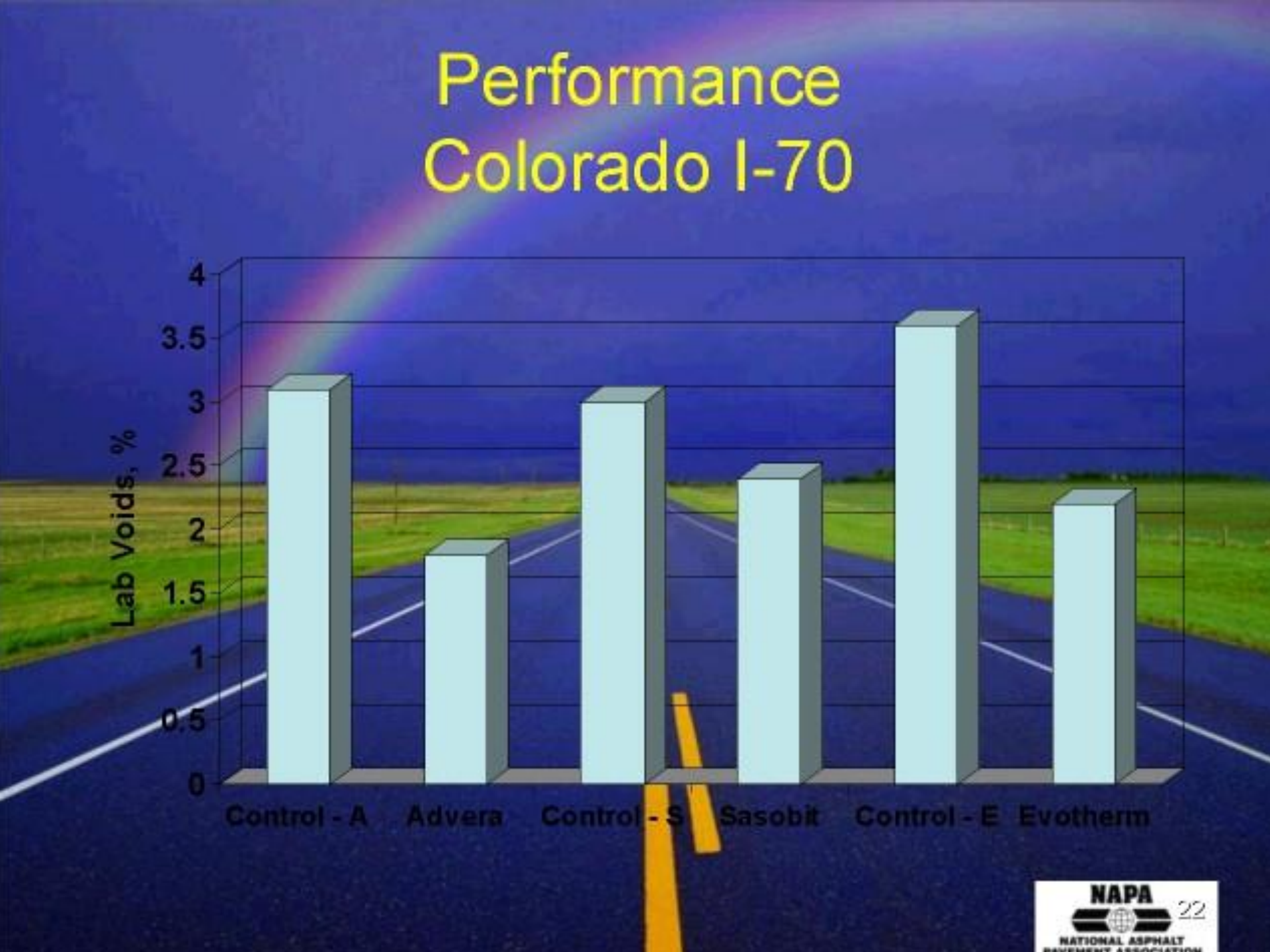
Courtesy AAT

Binder Grade and WMA

- Down to about 230^{o} F, no adjustment.
- Below this, may consider one high temperature grade greater.
- Low temperature grade is being evaluated.

CDOT WMA Project I-70

Performance
Colorado I-70



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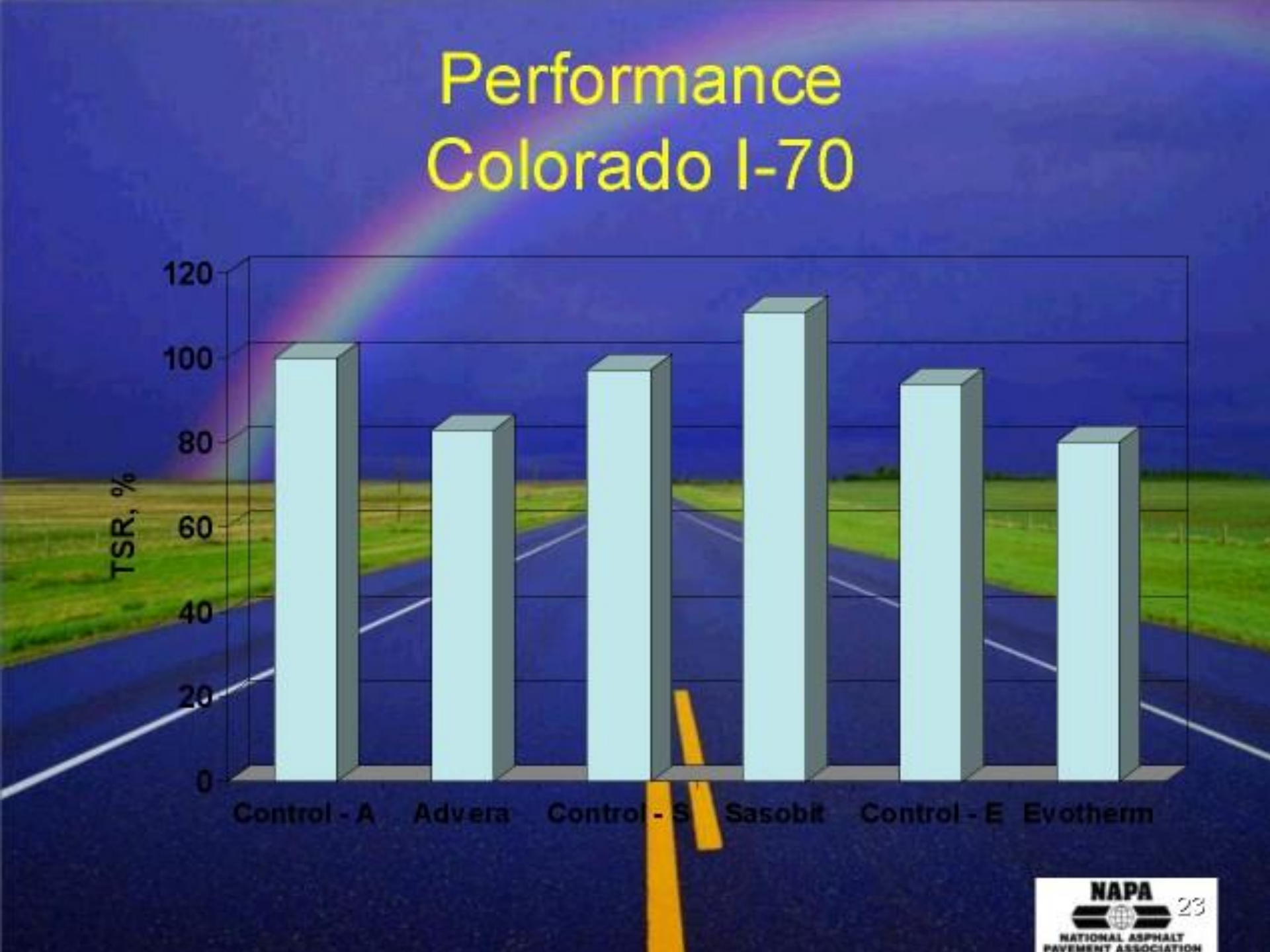

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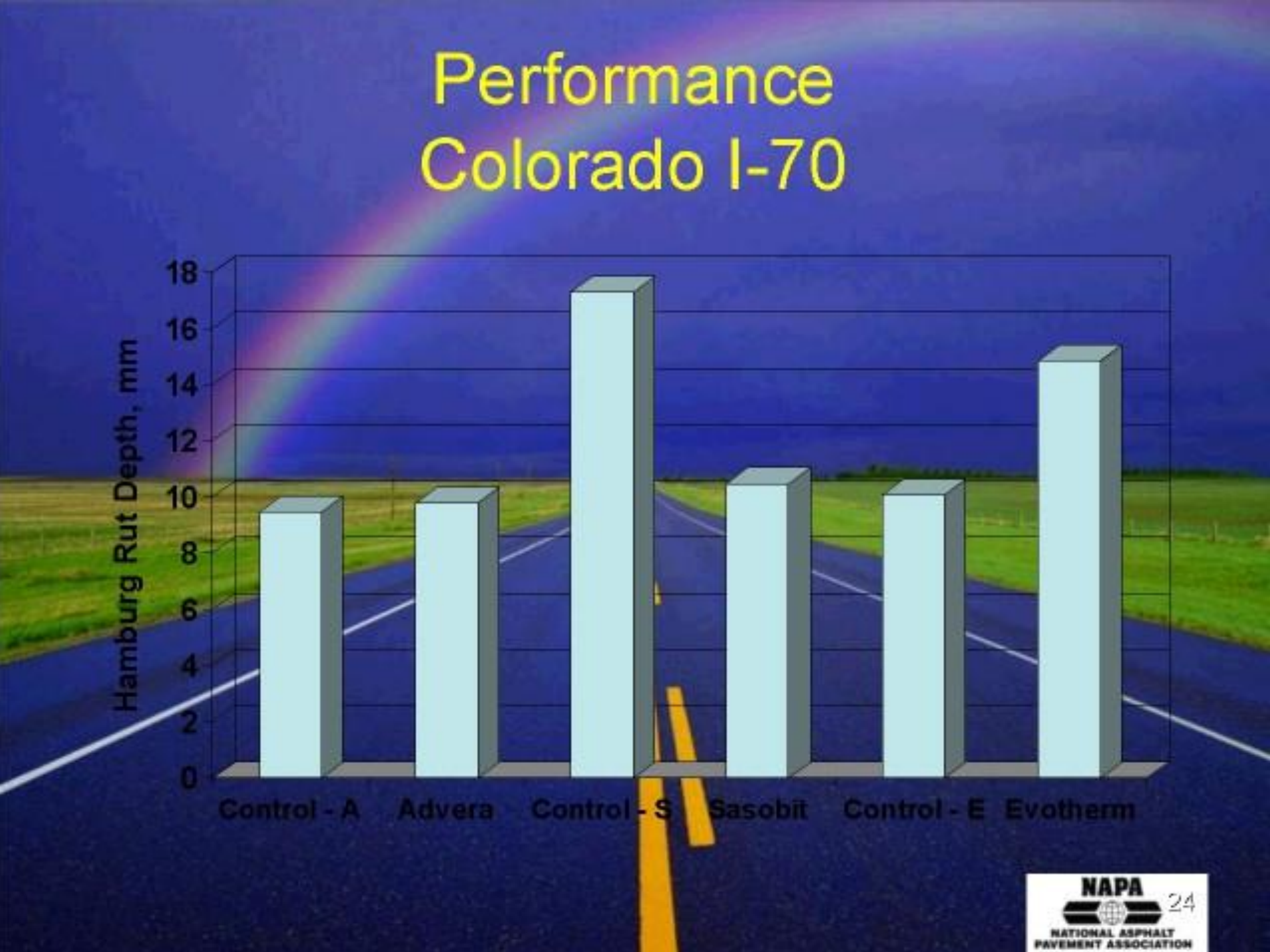


LEA Field Density

Mix	Avg. Gmb	Avg. %Gmm	SD
HMA control – Rt. 96B	2.278	94.1	1.43
LEA control – Rt. 96B	2.298	95.6	0.51

Absorption

Warm Mix

Hot Mix

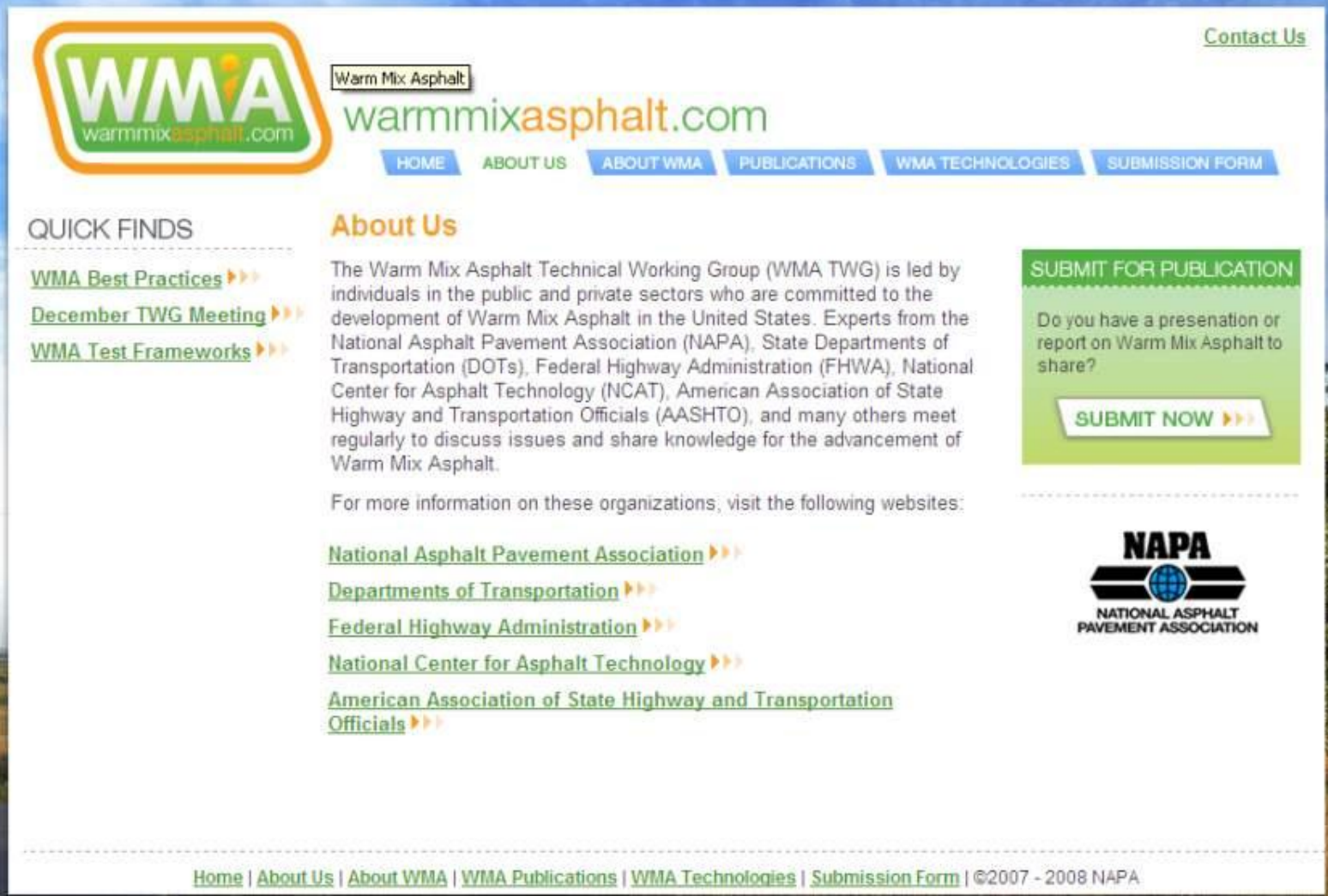
Reduced Emissions

Data provided by suppliers.

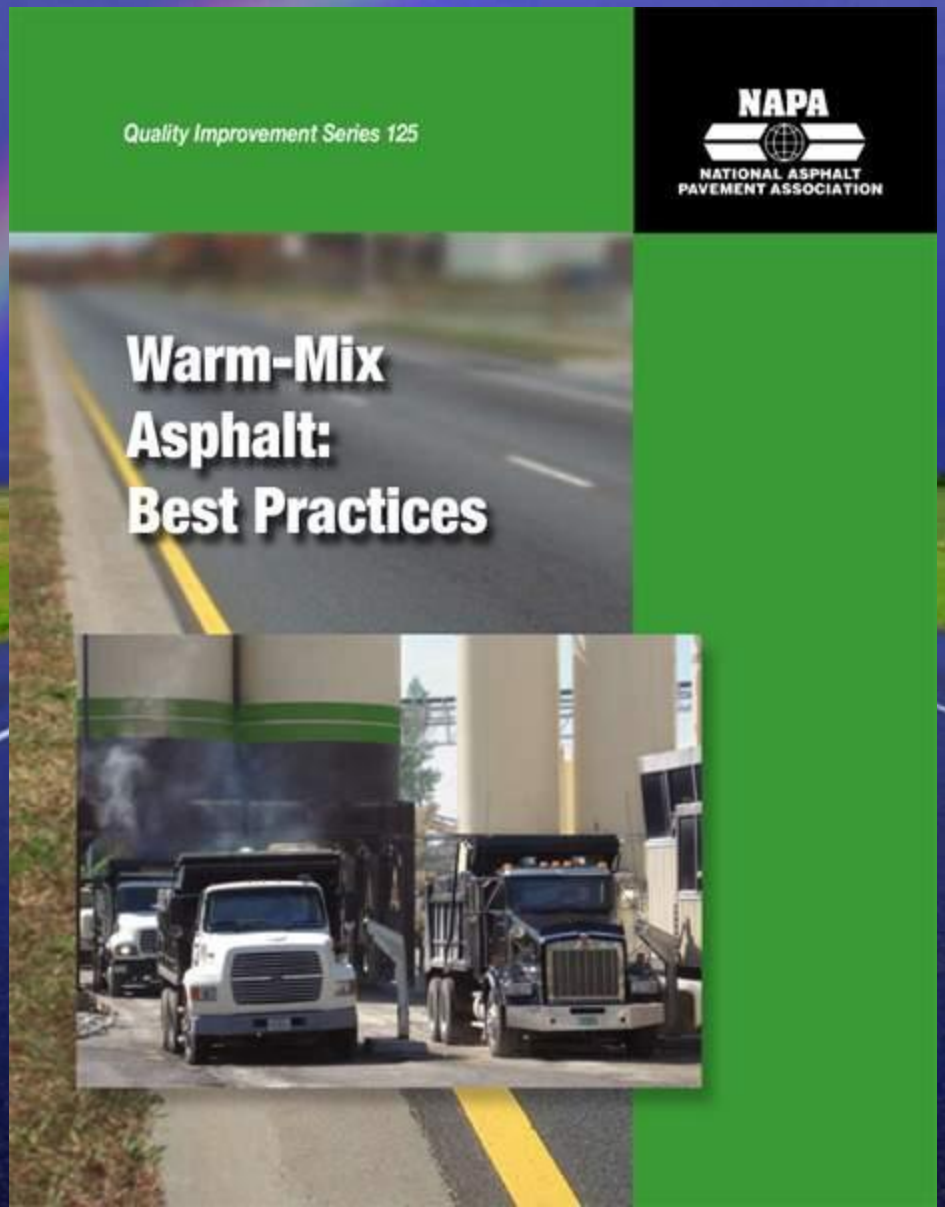
- Aspha-min – North Carolina – 265ºF
  - 17.6% decrease in SO_2
  - 3.2% decrease in CO_2
  - 35.3% decrease in total hydrocarbons
  - 6.1% decrease in NO_x
- Evotherm – Canada – 140ºF
  - 45.8% decrease in CO_2
  - 63.1% decrease in CO
  - 41.2% decrease in SO_2
  - 58% decrease in NO_x
- Direct comparisons are discouraged – different plants, different weather, different temperatures

States that have or will have
Permissive WMA Specifications

www.warmmixasphalt.com



Publication



How Does WMA Fit Into Pavement Preservation?

- Thin Lift HMA
  - Wider Paving Temp Range
  - Longer Haul Distances
  - Late Season Paving
- Specialty Mixes
  - Rubber Modified Binders and Mixes
  - Open-Graded Friction Courses
  - SMA

Why we need Warm Mix

- Better air quality
- Better energy efficiency
- Better performance
- Better compaction
- Better working conditions

Where are we?

- Development is proceeding rapidly.
  - More technology providers
- Over 30M tons to date.
- Adoption will happen within the next few years.
- Permissive specifications must be developed.

Where are we?

- All applications of HMA have been tried:
  - Dense-graded
  - SMA
  - OGFC
- What research is needed?
  - Mix Design – NCAT and NCHRP
  - Engineering and Environmental Performance – NCAT and NCHRP Efforts
  - Need long-term performance studies

Conclusions

- Warm Mix is the Future of Asphalt Mixtures.
- Technology providers coming forward.
- Industry and agencies must work together to make it happen.
- Advantages outweigh concerns.
- Will add to versatility of the material.