



# Achieving Sustainability Goals with Warm Mix Asphalt

Katrina Mangiaracina

March 7, 2023

# Agenda

Ingevity Overview

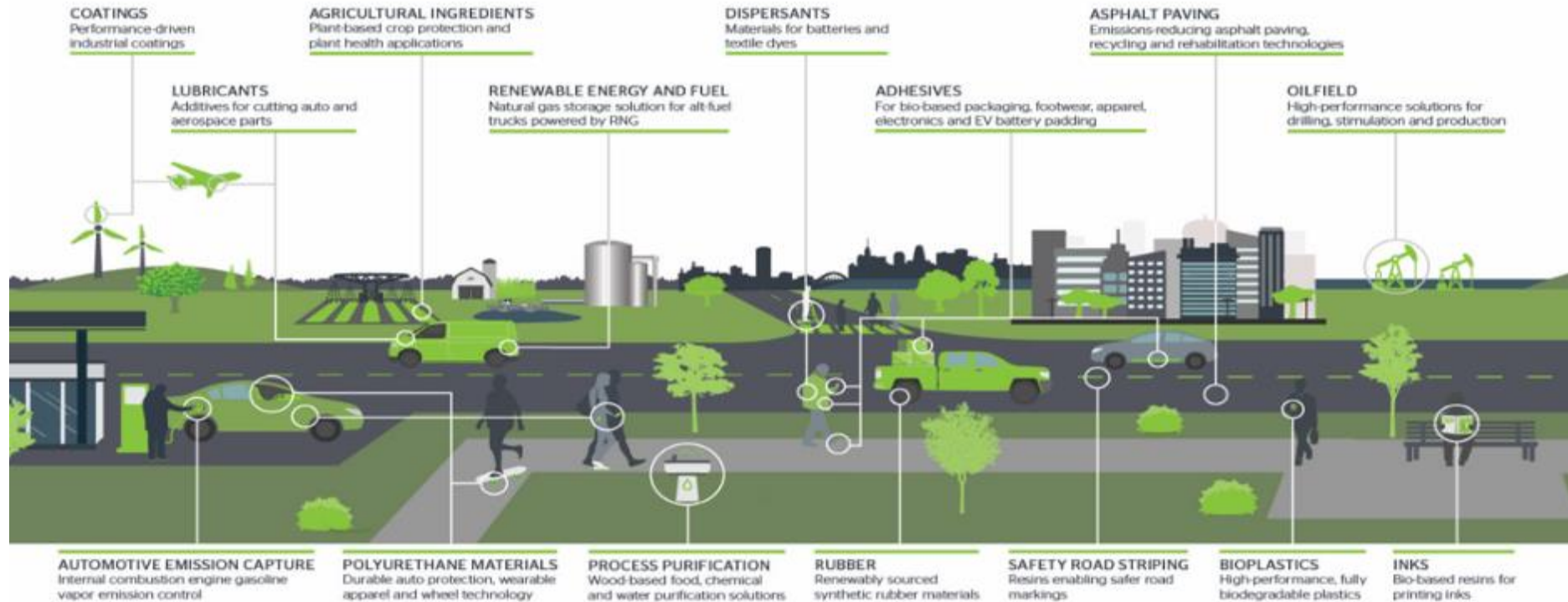
Past & Present Use of Warm Mix Asphalt

Benefits of Lower Production Temps

Meeting Contractor Needs with Data

Path Forward

# PURIFYING, PROTECTING AND ENHANCING EVERYDAY LIFE





A yellow CAT steamroller is paving a road in a forest. The steamroller is moving from left to right, leaving a fresh layer of asphalt behind it. The road is bordered by a rocky embankment on the left and tall pine trees on the right. The sky is blue with some clouds. A dark grey rectangular box is overlaid on the upper left portion of the image, containing the title text. A small bright green square is located in the top left corner of the image.

# Brief History of WMA



# NAPA Survey on WMA Usage – 2021

The National Asphalt Paving Association (NAPA) has conducted a systematic survey of asphalt mixture producers across the United States to quantify the use of recycled materials and the production of WMA from 2009 until 2021.



## Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage 2021

Information Series 138



12th Annual Survey

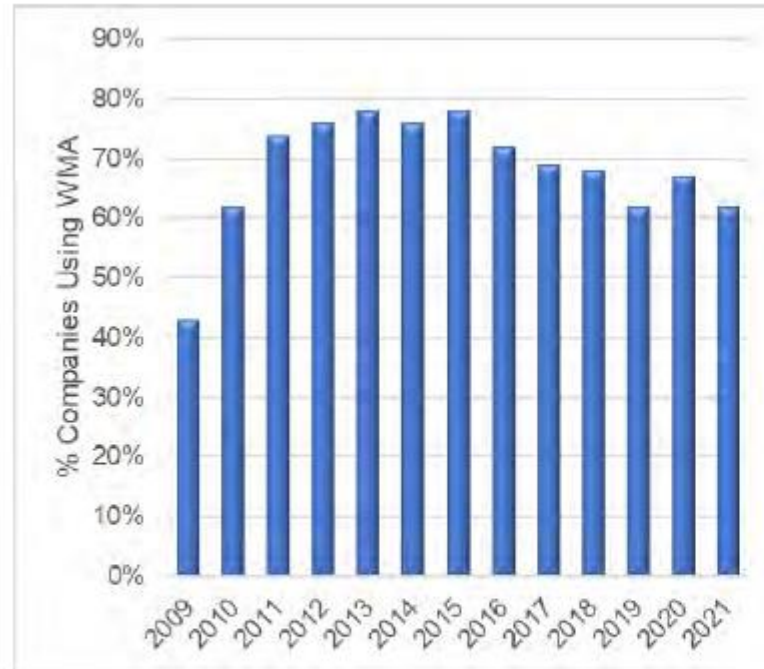


Figure 14: Percent of Companies Using WMA Technologies

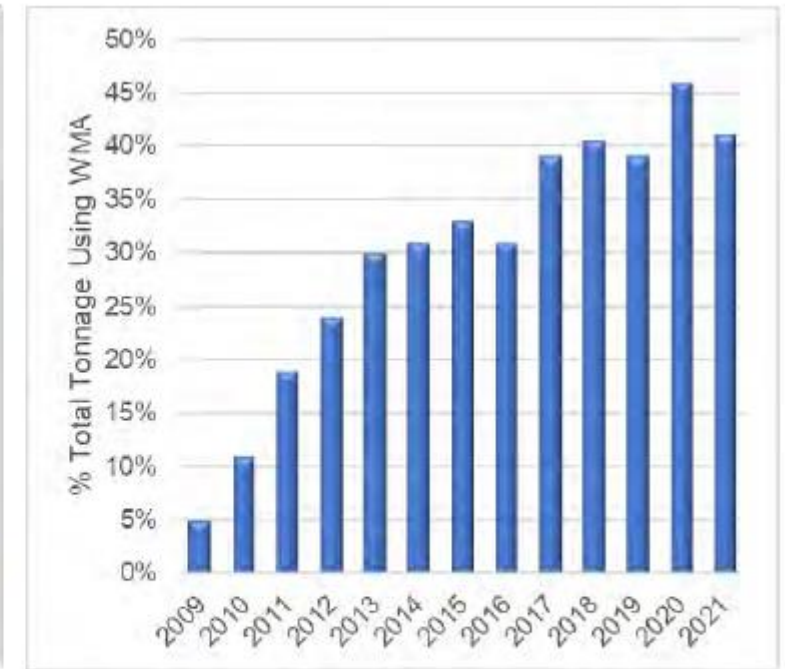
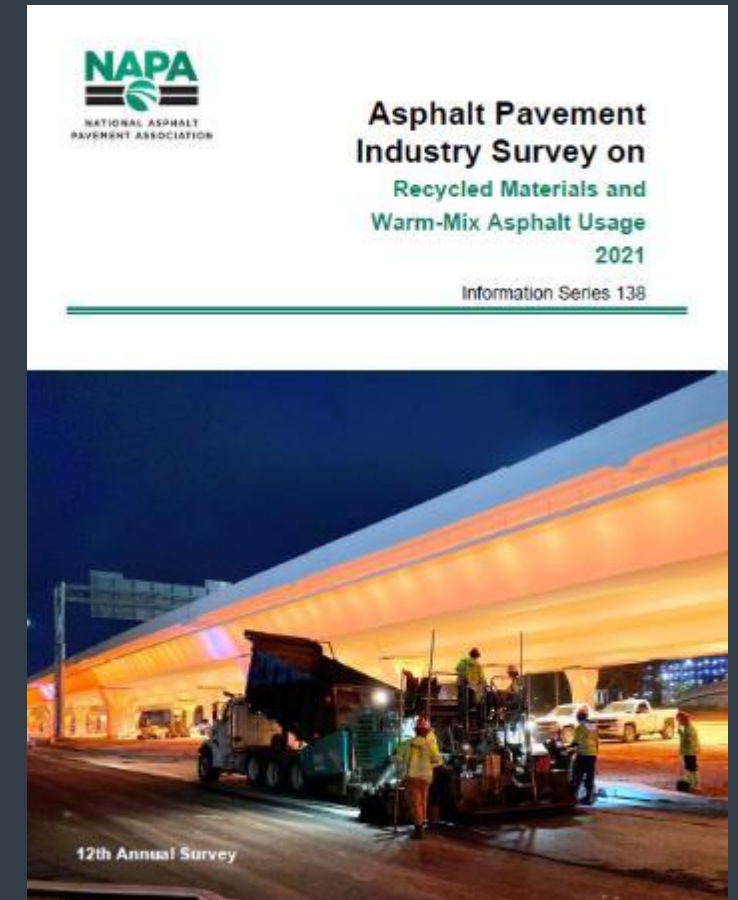
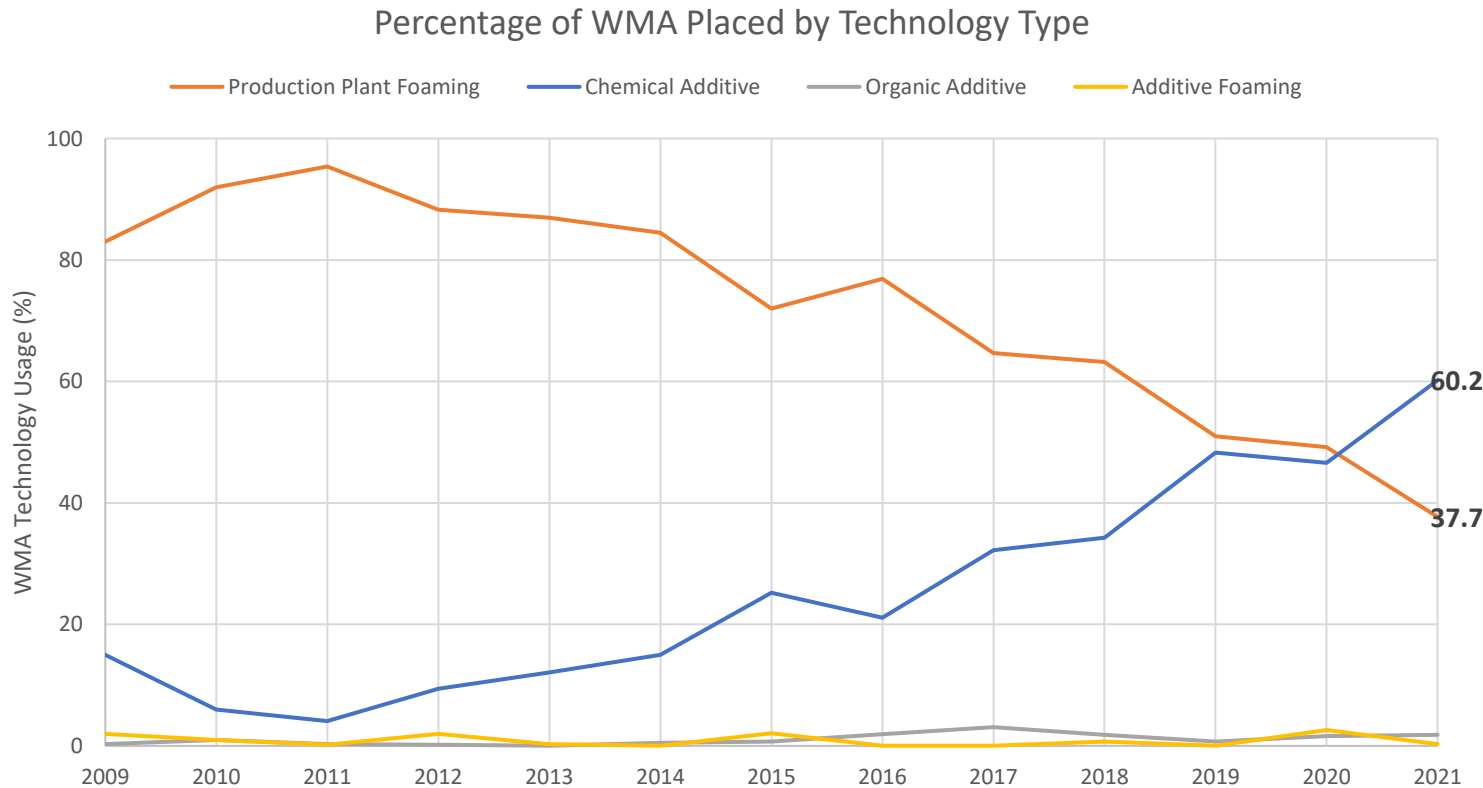


Figure 15: Percent Total Tonnage Produced Using WMA Technologies

# NAPA Survey on WMA Usage – 2021



Data taken from NAPA's "Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2021"



| WMA Technology           | % Production |      |      |      |      |      |      |      |      |      |      |      |      |
|--------------------------|--------------|------|------|------|------|------|------|------|------|------|------|------|------|
|                          | 2009         | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
| Production Plant Foaming | 83           | 92   | 95.4 | 88.3 | 87   | 84.5 | 72   | 76.9 | 64.7 | 63.2 | 51   | 49.2 | 37.7 |
| Additive Foaming         | 2            | 1    | 0.2  | 2    | 0.3  | 0    | 2.1  | 0    | 0    | 0.7  | 0    | 2.6  | 0.3  |
| Chemical Additive        | 15           | 6    | 4.1  | 9.4  | 12.1 | 15   | 25.2 | 21.1 | 32.2 | 34.3 | 48.3 | 46.6 | 60.2 |
| Organic Additive         | 0.3          | 1    | 0.3  | 0.2  | 0    | 0.5  | 0.7  | 1.9  | 3.1  | 1.8  | 0.7  | 1.6  | 1.8  |



# Current Use of WMA

- Cheap Insurance
- Improved compaction
  - Density bonus
  - Reduce rollers
- Cold Weather Paving
  - Start earlier – pave longer
- Long Haul – Better Silo Storage
- Reduced Absorption – Lower AC Content
- Liquid Anti-Strip and Lime replacement
- Increased recycle usage – improved workability
- Decrease mix temperature
  - Reduced thermal segregation
  - Longer binder life
  - Reduced fuel consumption
  - Reduced emissions
  - BMD



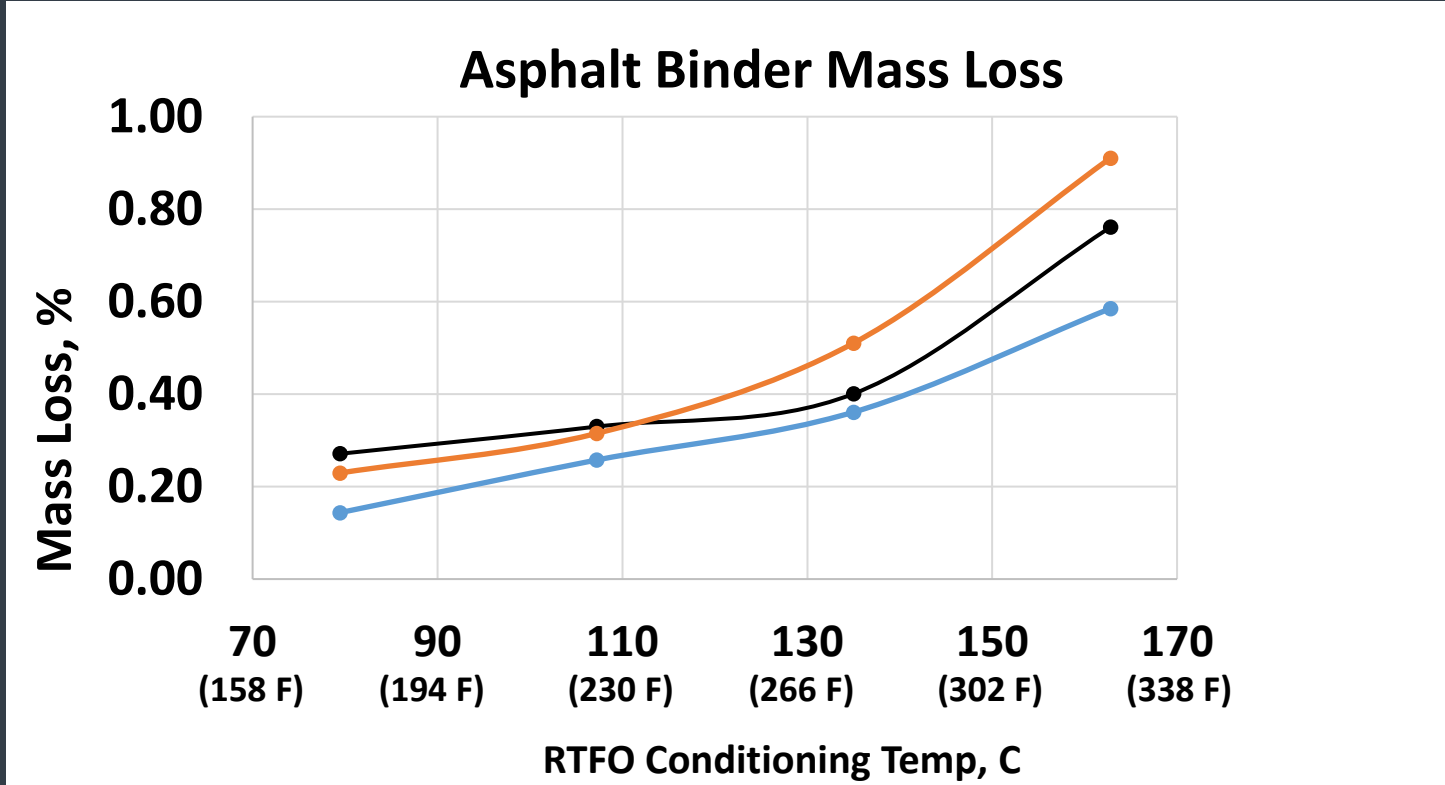




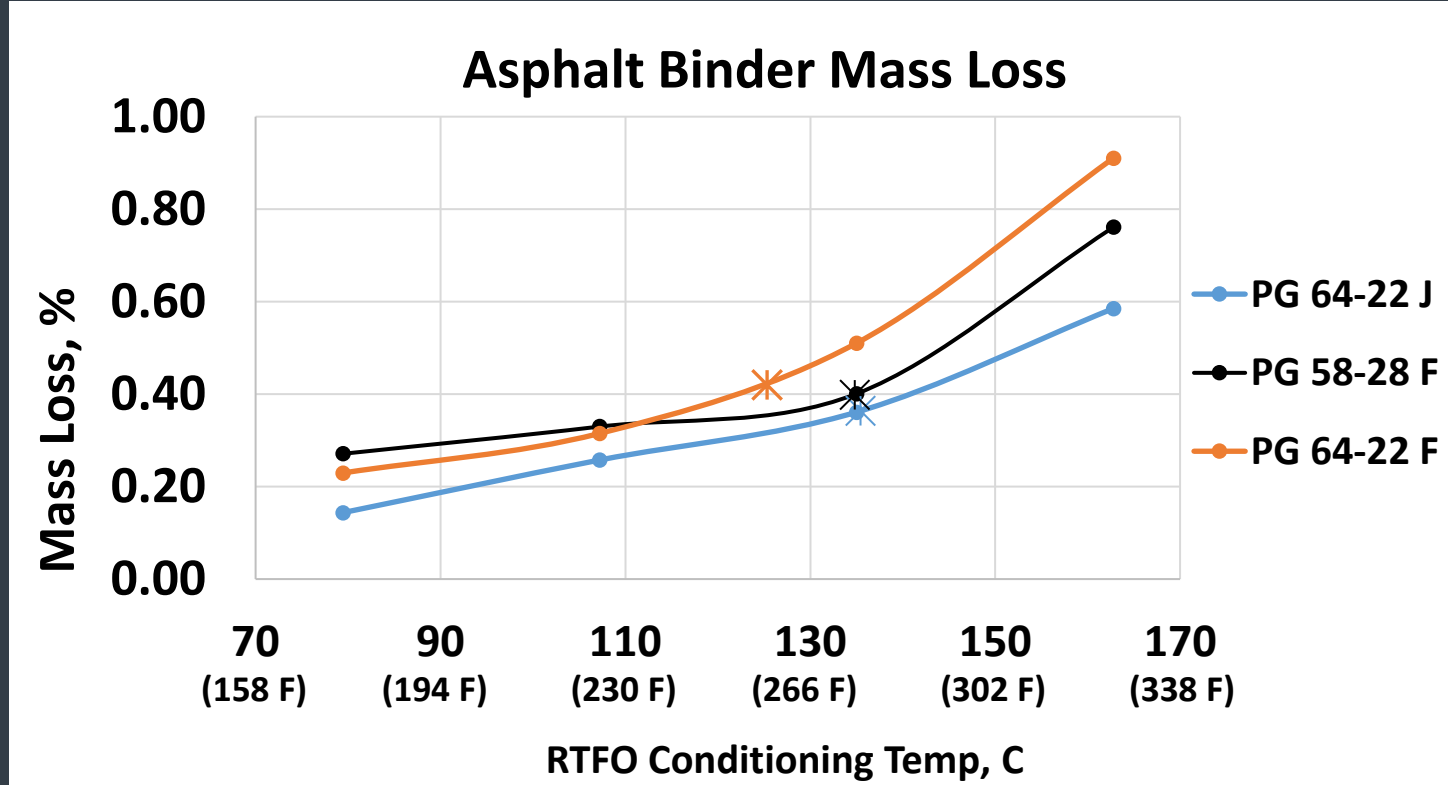
# Benefits of Lower Production Temperatures



# Binder Mass Loss vs RTFO Temperatures

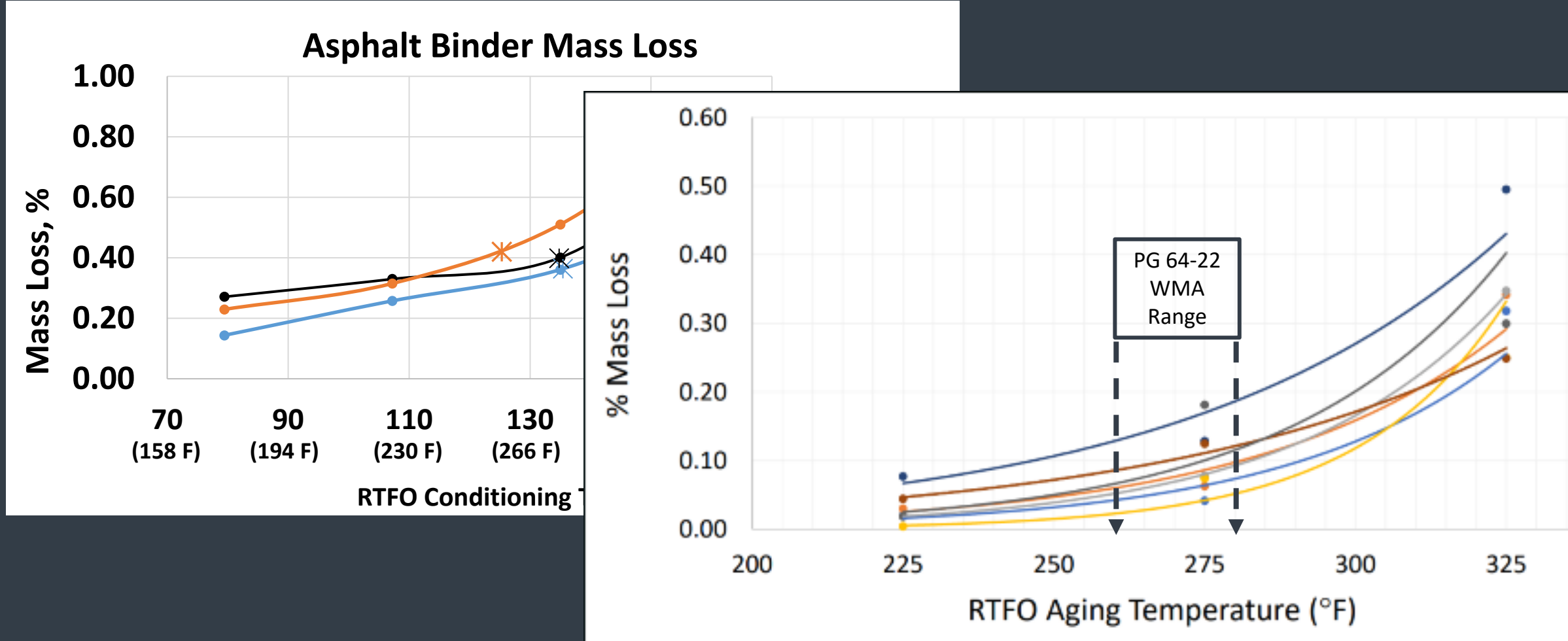


# Binder Mass Loss vs RTFO Temperatures



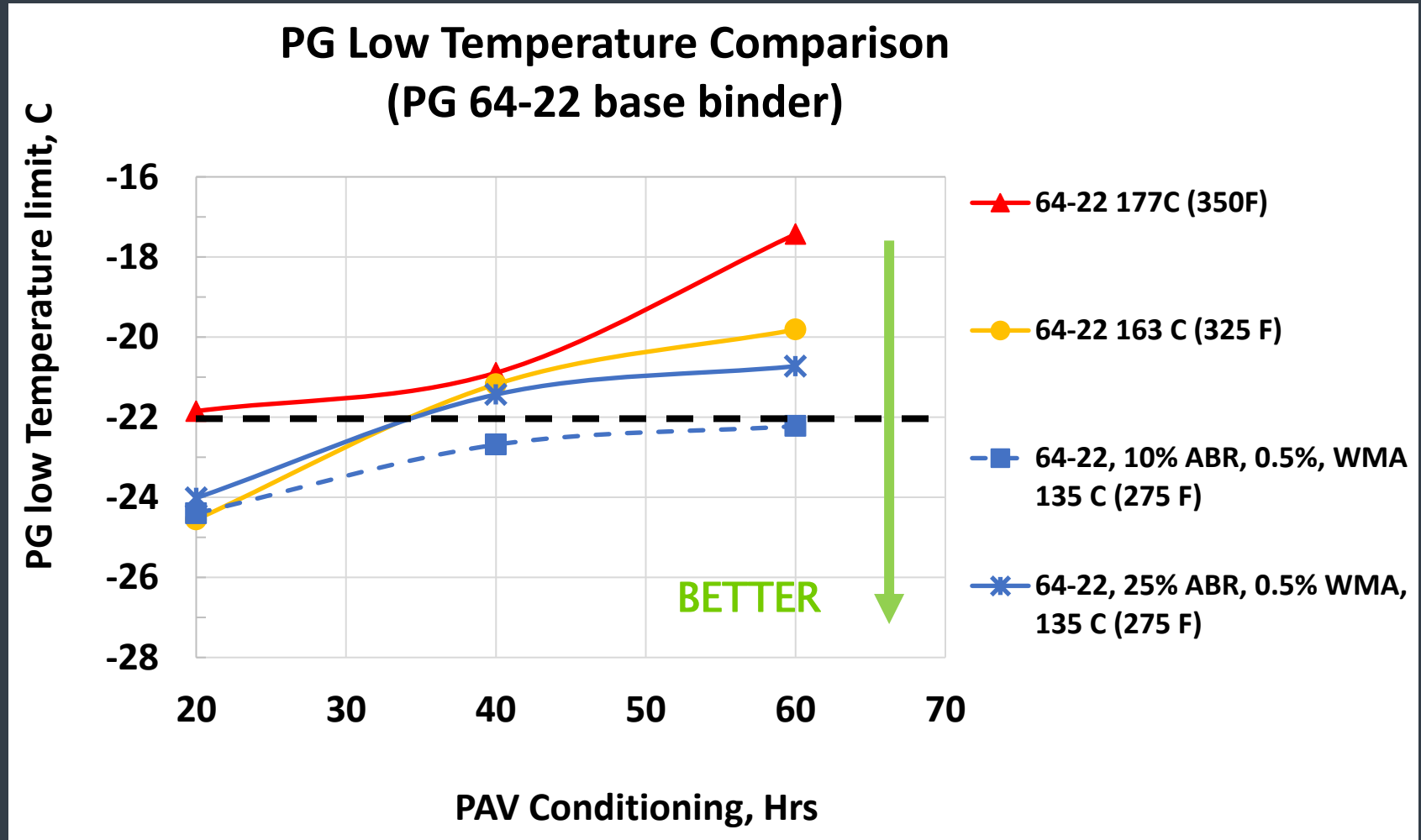


# Binder Mass Loss vs RTFO Temperatures



# PG Low Temp After Extended Aging

- 20 Hr PAV is common aging limit for PG specifications
- PG 64-22 RTFO 350F is out of spec after 20 Hr PAV
- Reducing RTFO 50F still meets spec after 60 Hrs



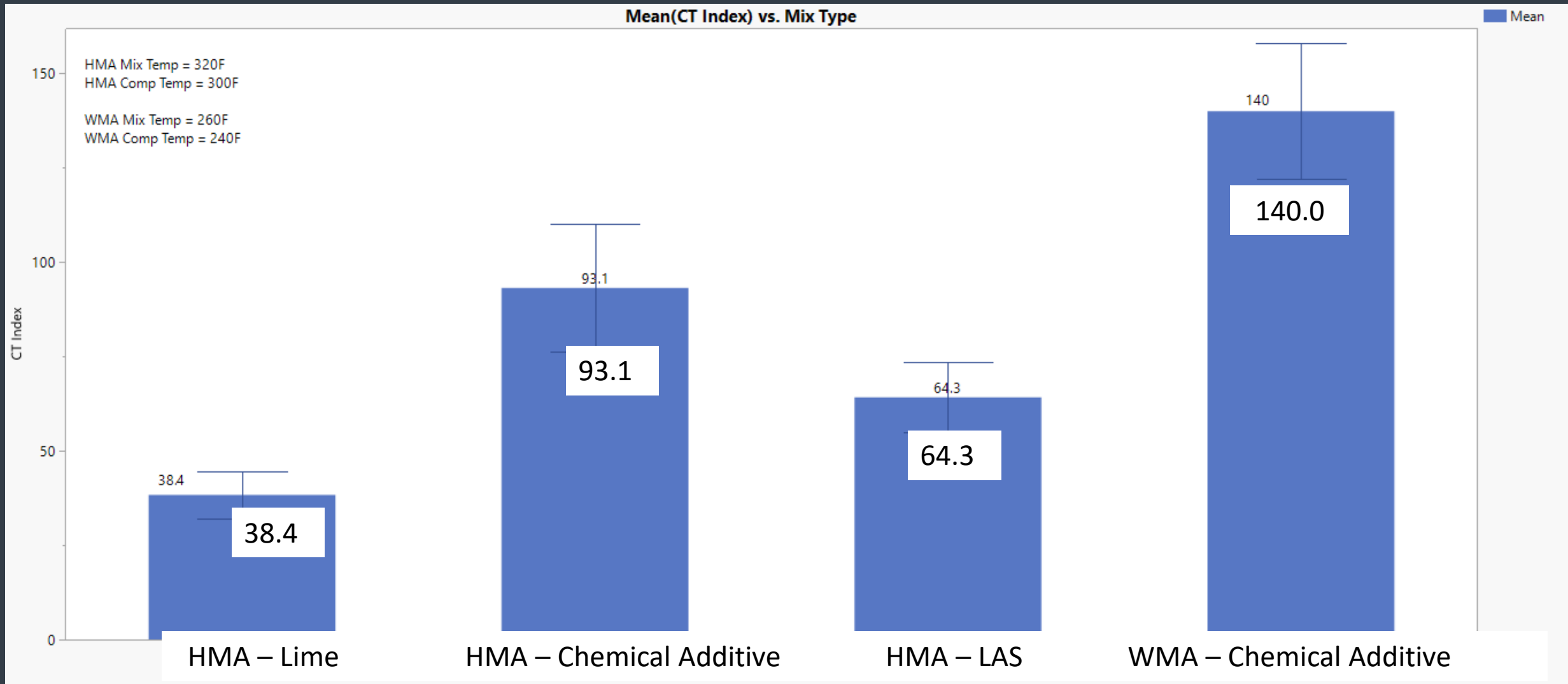
5yrs

10yrs

15yrs



# SC WMA vs HMA – Ideal CT Results



# NY WMA vs HMA – Report

## Overlay Test (OT)

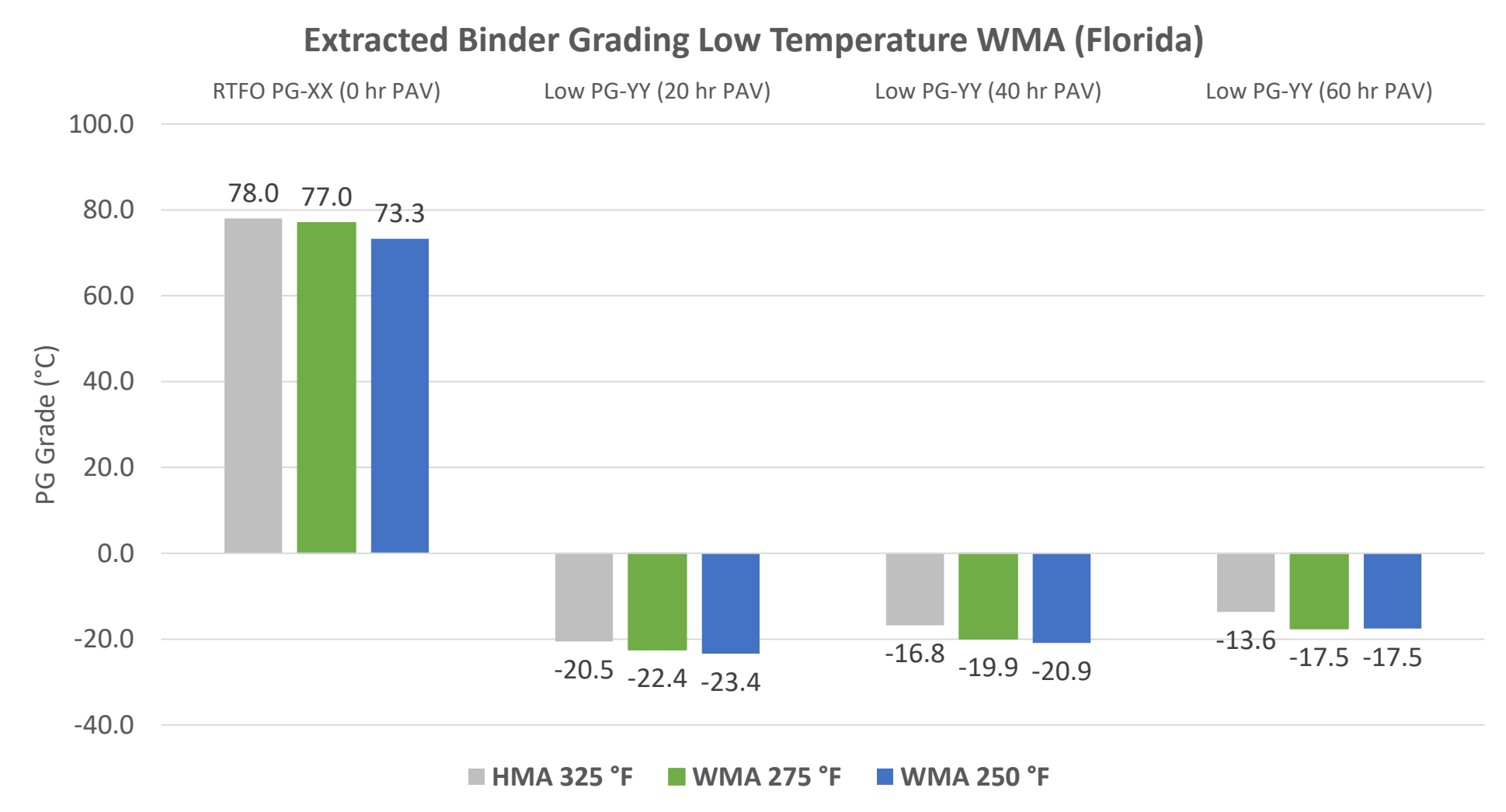
| NMAS    | WMA TEMP. | HMA TEMP. | PG    | RAP % | ESAL'S | Overlay Tester (cycles) |     | t-Test Results |
|---------|-----------|-----------|-------|-------|--------|-------------------------|-----|----------------|
|         |           |           |       |       |        | HMA                     | WMA |                |
| 12.5 mm | 275°F     | 315°F     | 70-22 | 15%   | <30.0  | 365                     | 432 | EQUAL          |
| 9.5 mm  | 260-265°F | 310-325°F | 70-22 | 10%   | <10.0  | 497                     | 670 | NOT EQUAL      |

## Asphalt Pavement Analyzer (APA)

| NMAS    | WMA TEMP. | HMA TEMP. | PG    | RAP % | ESAL'S | Asphalt Pavement Analyzer (mm) |      |      | t-Test Results |
|---------|-----------|-----------|-------|-------|--------|--------------------------------|------|------|----------------|
|         |           |           |       |       |        | 9-33 Spec                      | HMA  | WMA  |                |
| 12.5 mm | 275°F     | 315°F     | 70-22 | 15%   | <30.0  | <4.0                           | 4.39 | 3.19 | NOT EQUAL      |
| 9.5 mm  | 260-265°F | 310-325°F | 70-22 | 10%   | <10.0  | <5.0                           | 5.03 | 4.76 | EQUAL          |

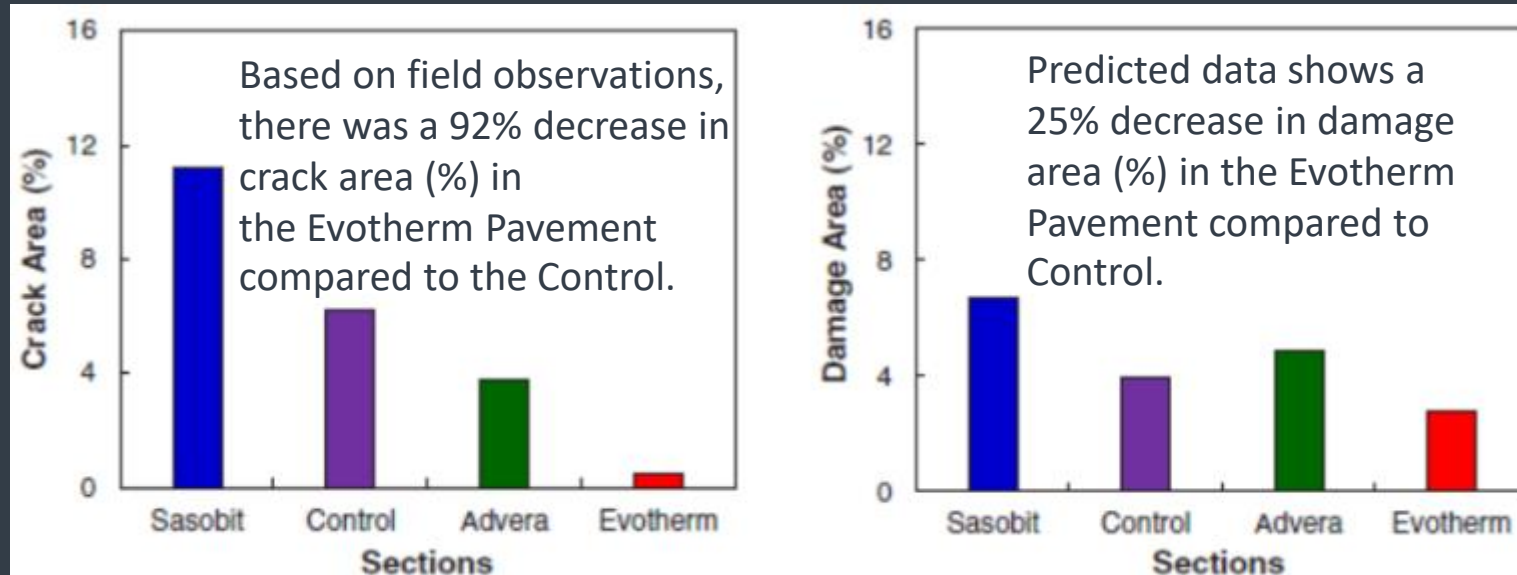
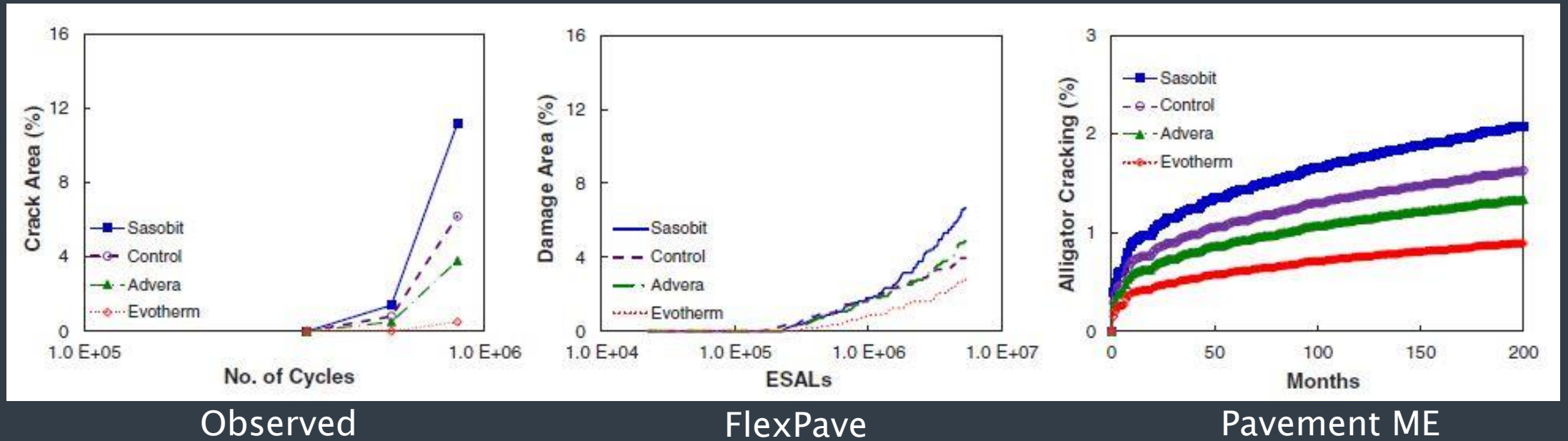
Bennert, Thomas. "Early Age Rutting Potential of Warm Mix Asphalt (WMA)." RFP Number C-10-08. December 2012

# Recovered Binder Data (Florida)





# Observed vs Predicted WMA Field Performance



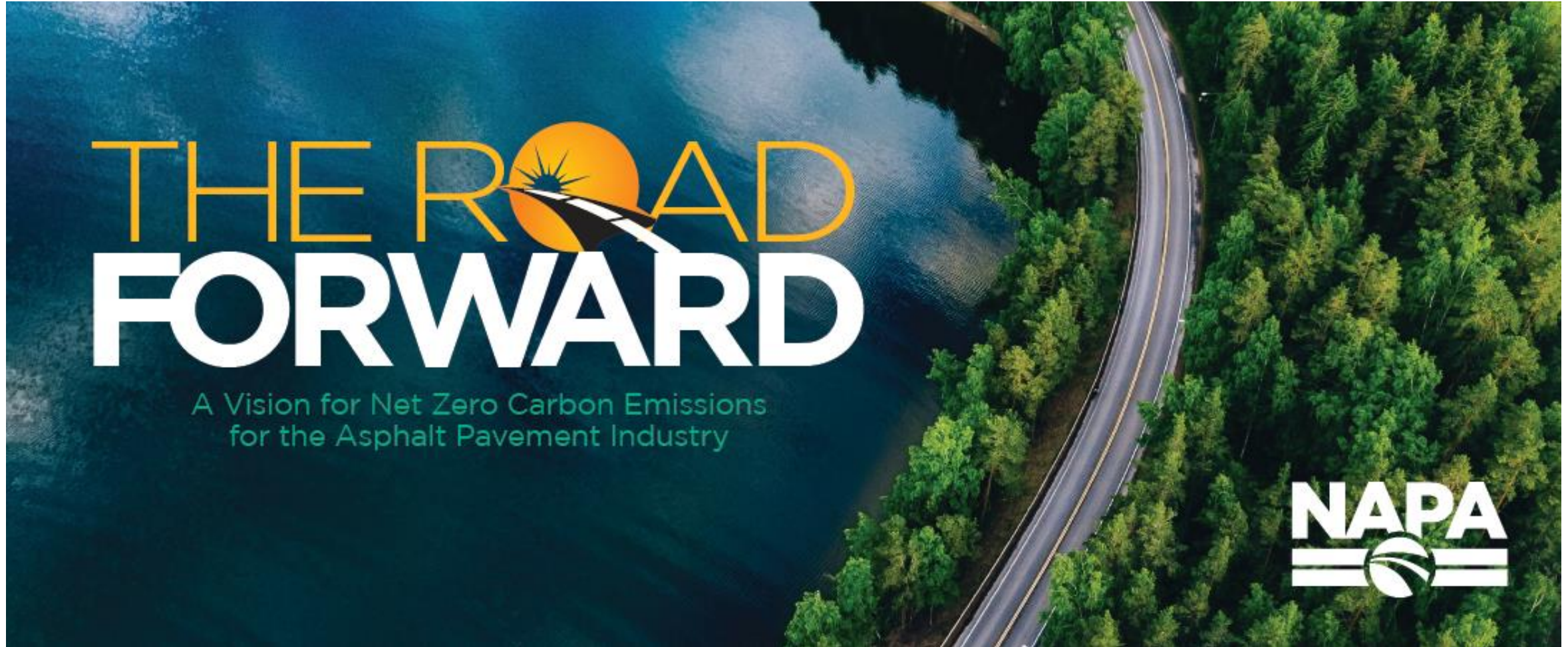


A yellow CAT steamroller is paving a road in a forest. The machine is moving from left to right, leaving a fresh layer of asphalt behind it. The road is bordered by a rocky embankment on the left and tall pine trees on the right. The sky is blue with some clouds. A semi-transparent dark grey box with white text is overlaid on the upper left portion of the image. A small solid green square is in the top left corner.

# Meeting Industry Goals with Data



# Our Industry Needs Leaders ...





# Improved Air Quality with WMA

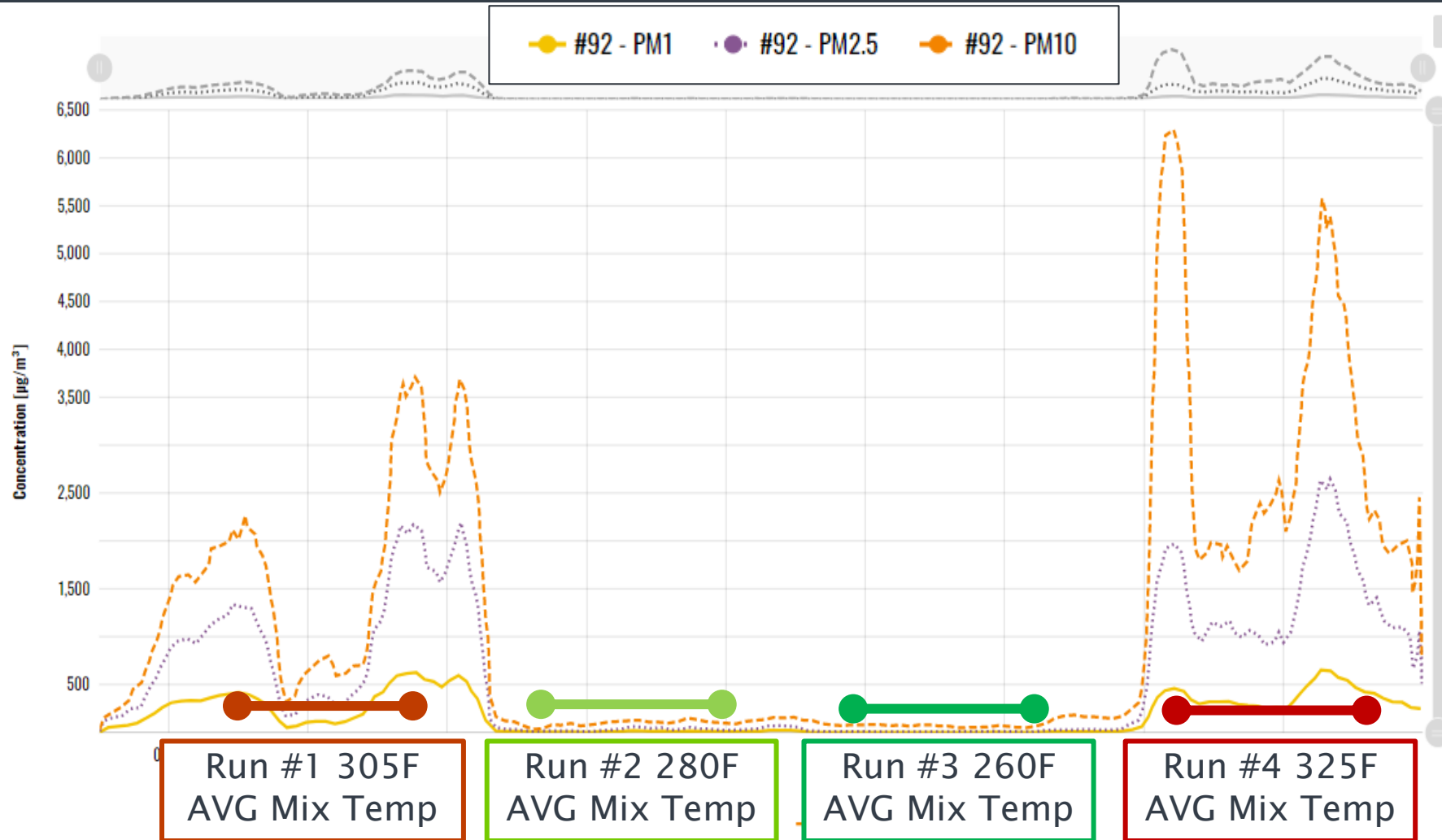
325° HMA



275° HMA



# Quantifying Emissions Reductions with True WMA



**APT  
Device**

# WMA Plant Fugitive Emissions Data 2022

## Project details from Contractor (Utah)

- 360 Tons/hr run rate
- Gencor Counter Flow Drum
- 15% RAP Content

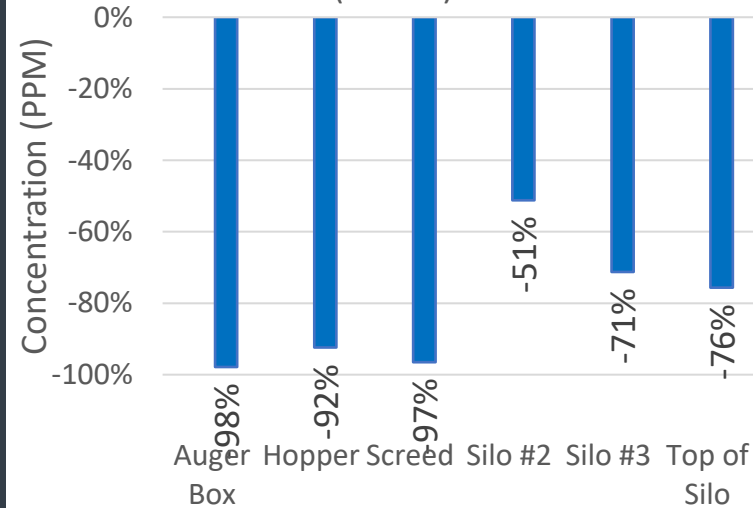
## Project Details from Contractor (Florida)

- 200 Tons/hr run rate
- Astec Double Barrel Green
- 40% RAP Content

## Project Details from Contractor (Virginia)

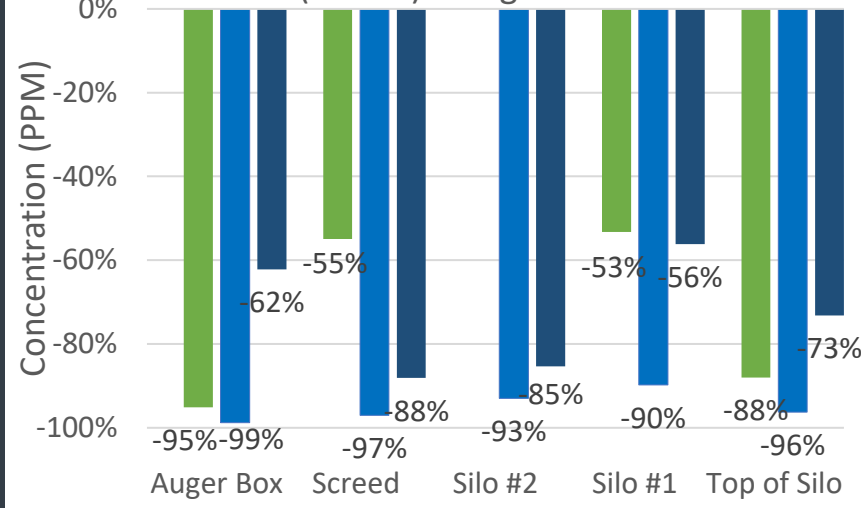
- 290 Tons/hr run rate
- Astec Double Barrel Green
- 30% RAP Content

Percent Reduction in Fugitive Emissions  
(PM2.5)



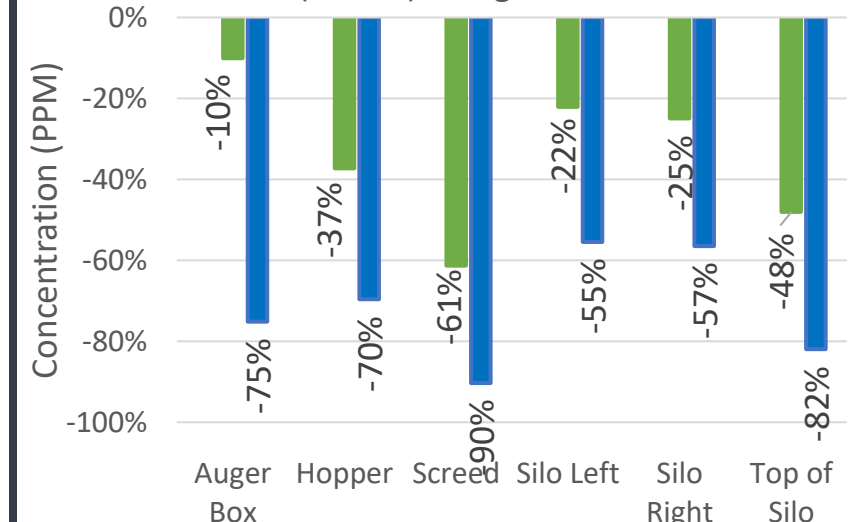
315°F -> 260°F

Percent Reduction in Fugitive Emissions  
(PM2.5) Using WMA



325°F -> 275°F -> 265°F -> 250°F

Percent Reduction in Fugitive Emissions  
(PM2.5) Using WMA



310°F -> 285°F -> 260°F



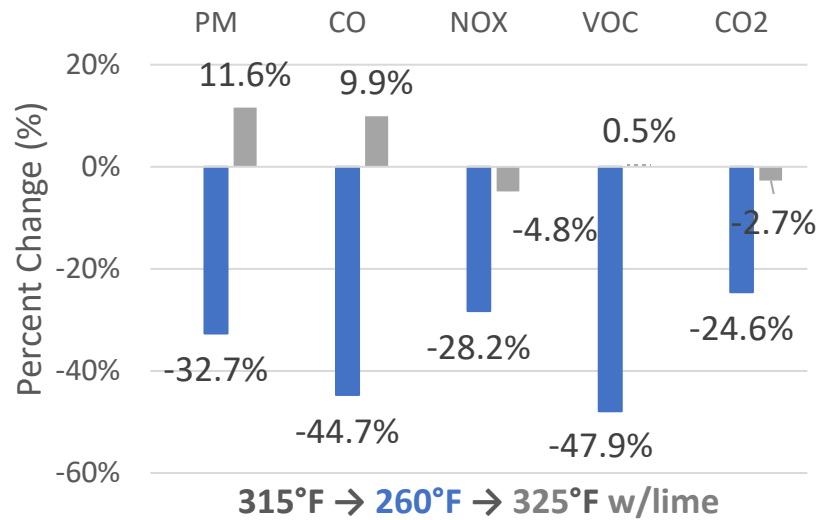


# WMA Plant Stack Emissions Data

## Input Data from Contractor (**Utah**)

- 360 Tons/hr run rate
- Gencor Counter Flow Drum
- 15% RAP Content

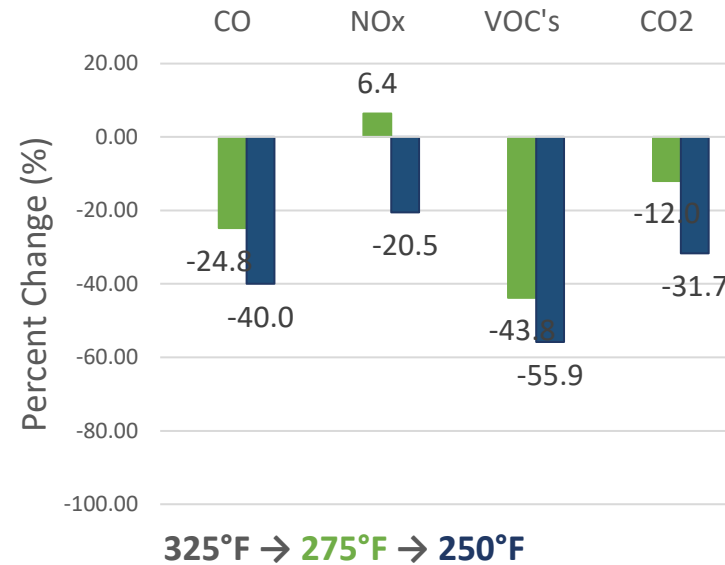
### Stack Emissions (Utah)



## Input Data from Contractor (**Florida**)

- 200 Tons/hr run rate
- Astec Double Barrel Green
- 40% RAP Content

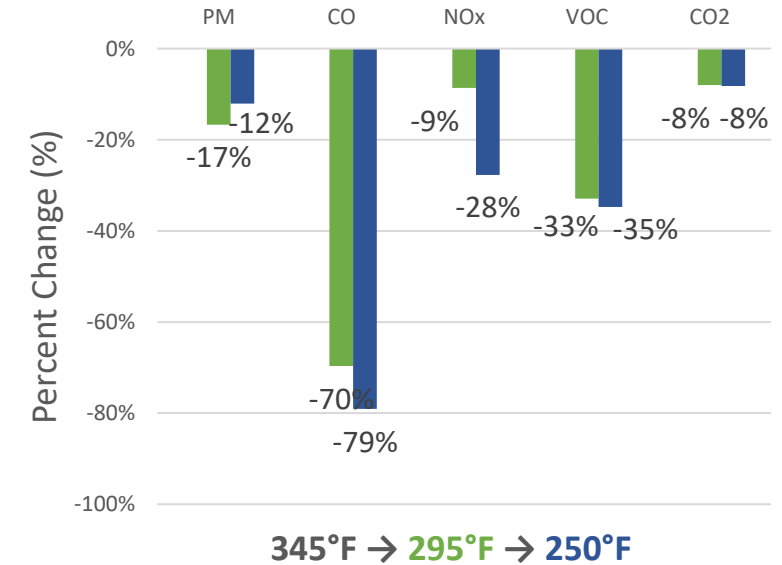
### Stack Emissions (Florida)



## Input Data from Contractor (**Ohio**)

- 240 Tons/hr run rate
- Astec Double Barrel
- 20% RAP Content

### Stack Emissions (Ohio)







# Recent Work in New York



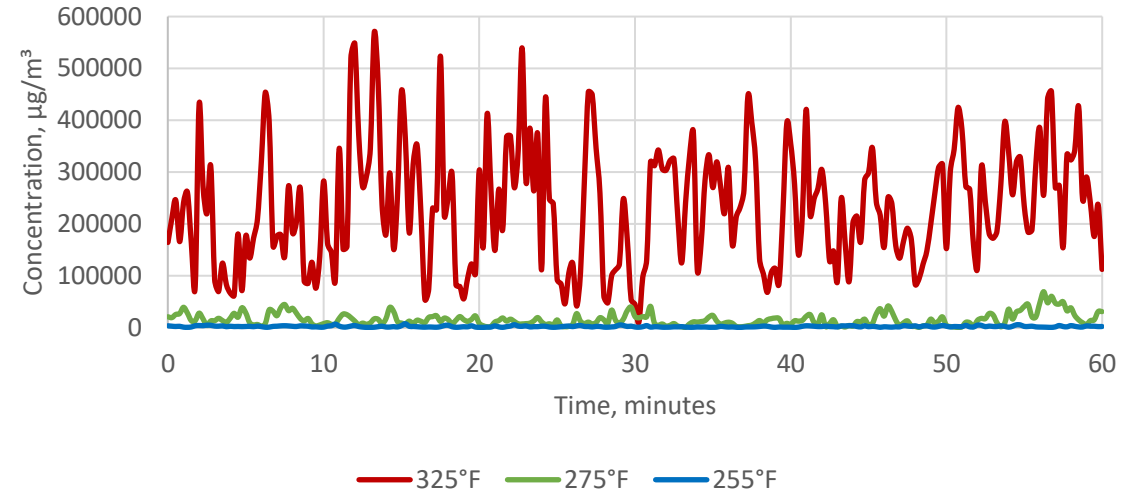
# WMA Fugitive Emissions Data New York 2022

## Project Details from Contractor (New York)

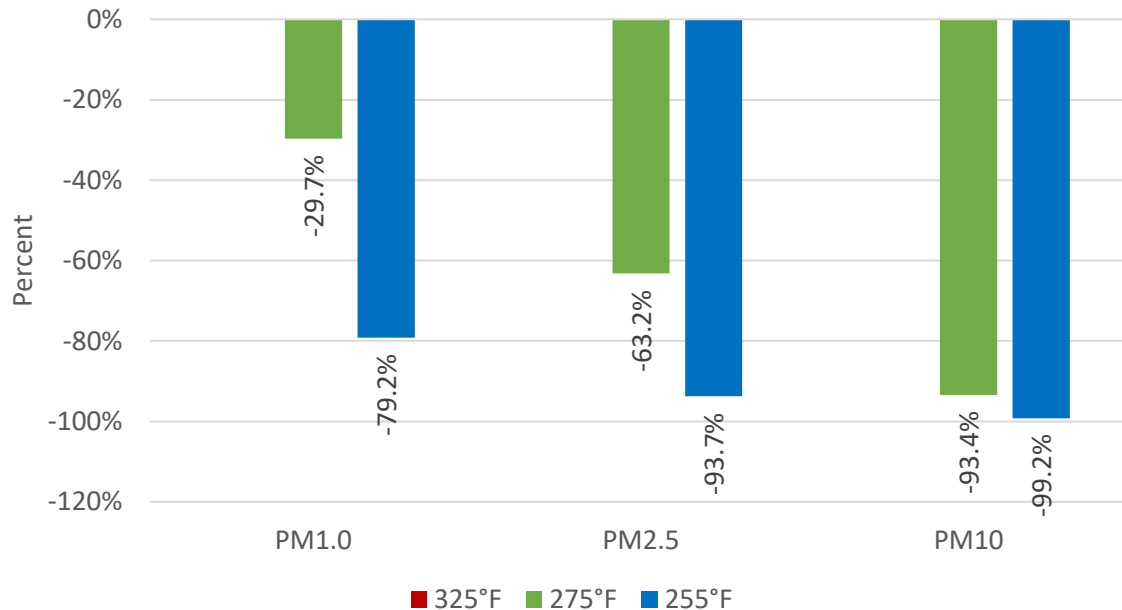
- 220 Tons/hr run rate
- Astec Double Barrel Green
- 20% RAP Content



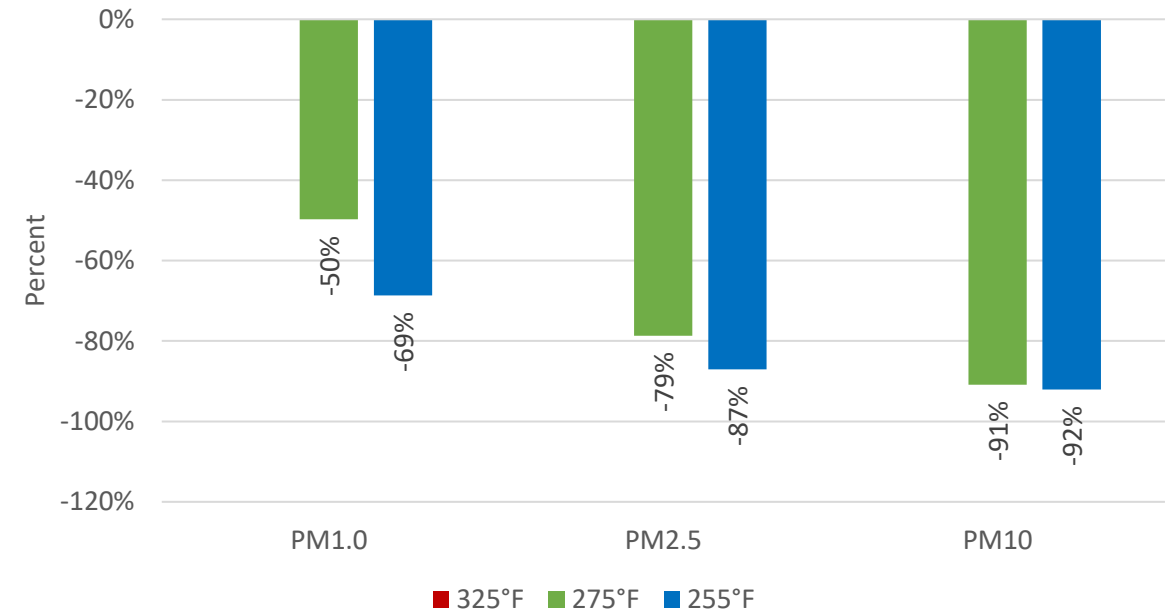
Comparison of HMA and WMA Particulate Matter (PM<sub>10</sub>) Emissions – Top of Silo



Percent Reduction Fugitive Emissions from HMA - Top of Silo



Percent Reduction Fugitive Emissions from HMA Run – Auger Box





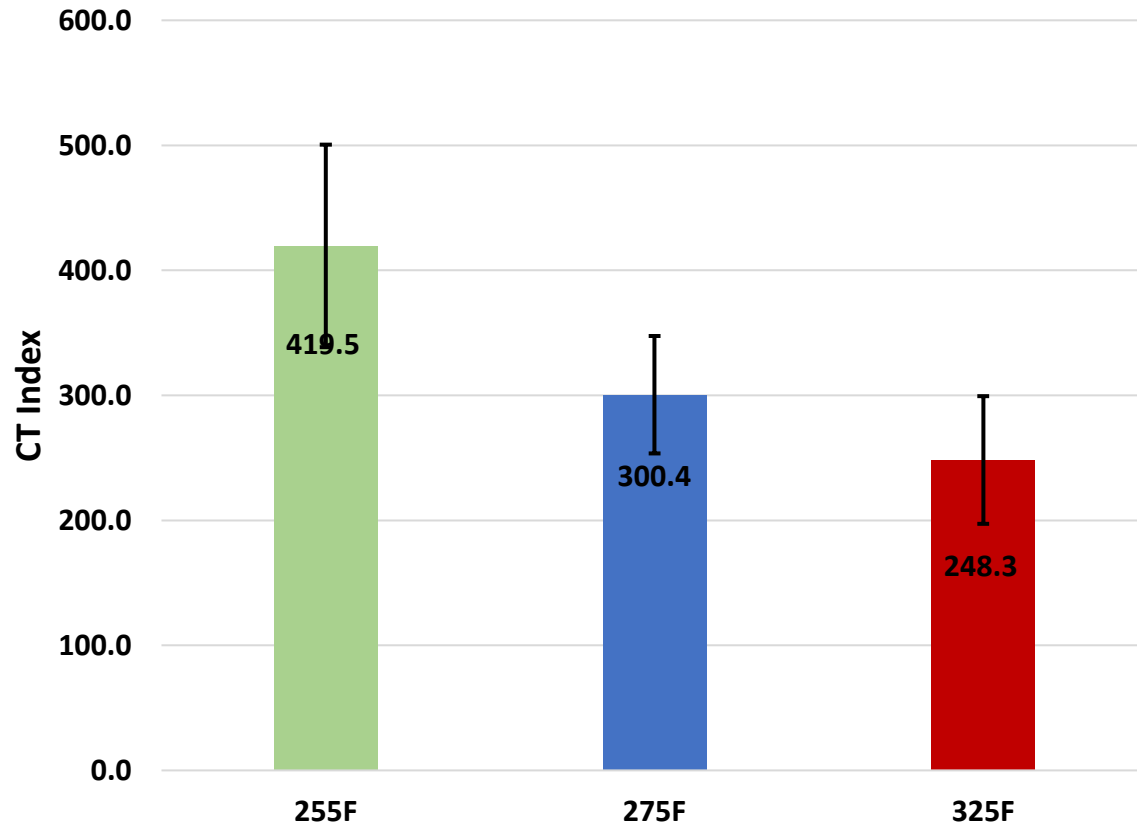
# WMA Plant Mix Data 2022

Project Details from Contractor (New York)

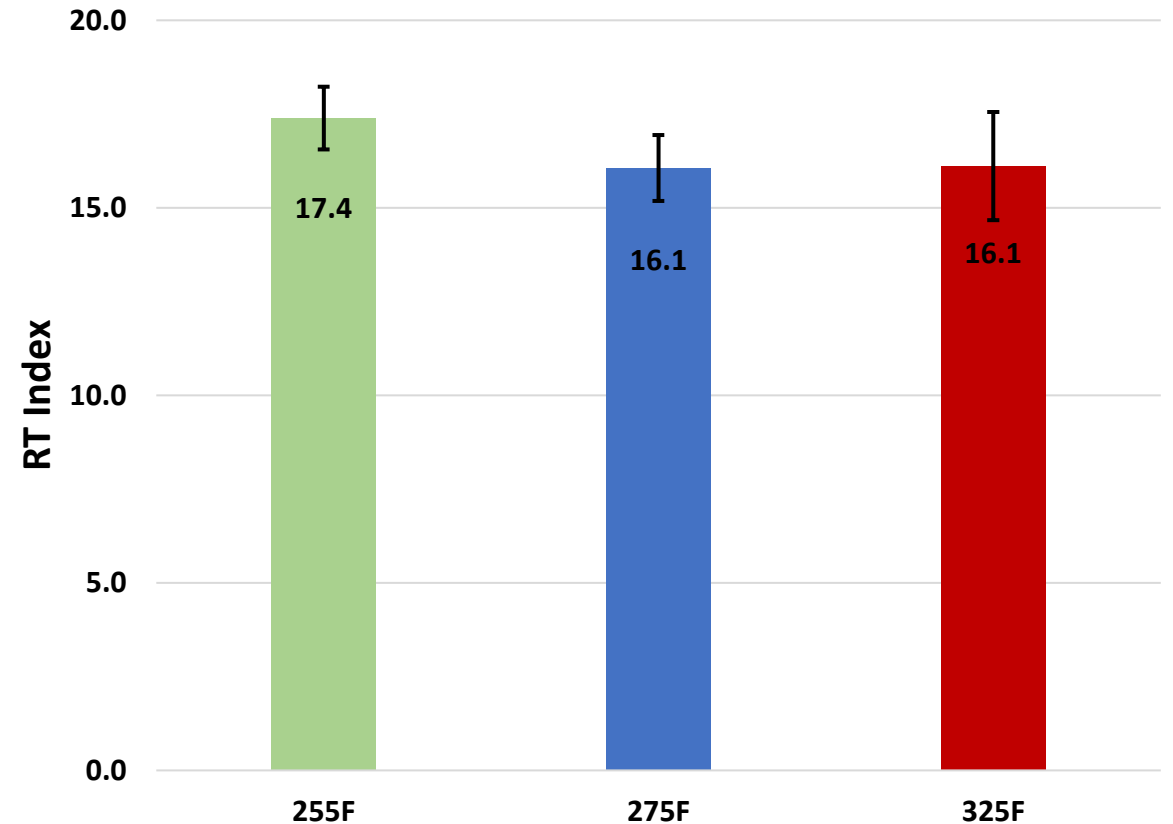
- 220 Tons/hr run rate
- Astec Double Barrel Green
- 20% RAP Content



Ideal CT (New York)



Ideal RT (New York)



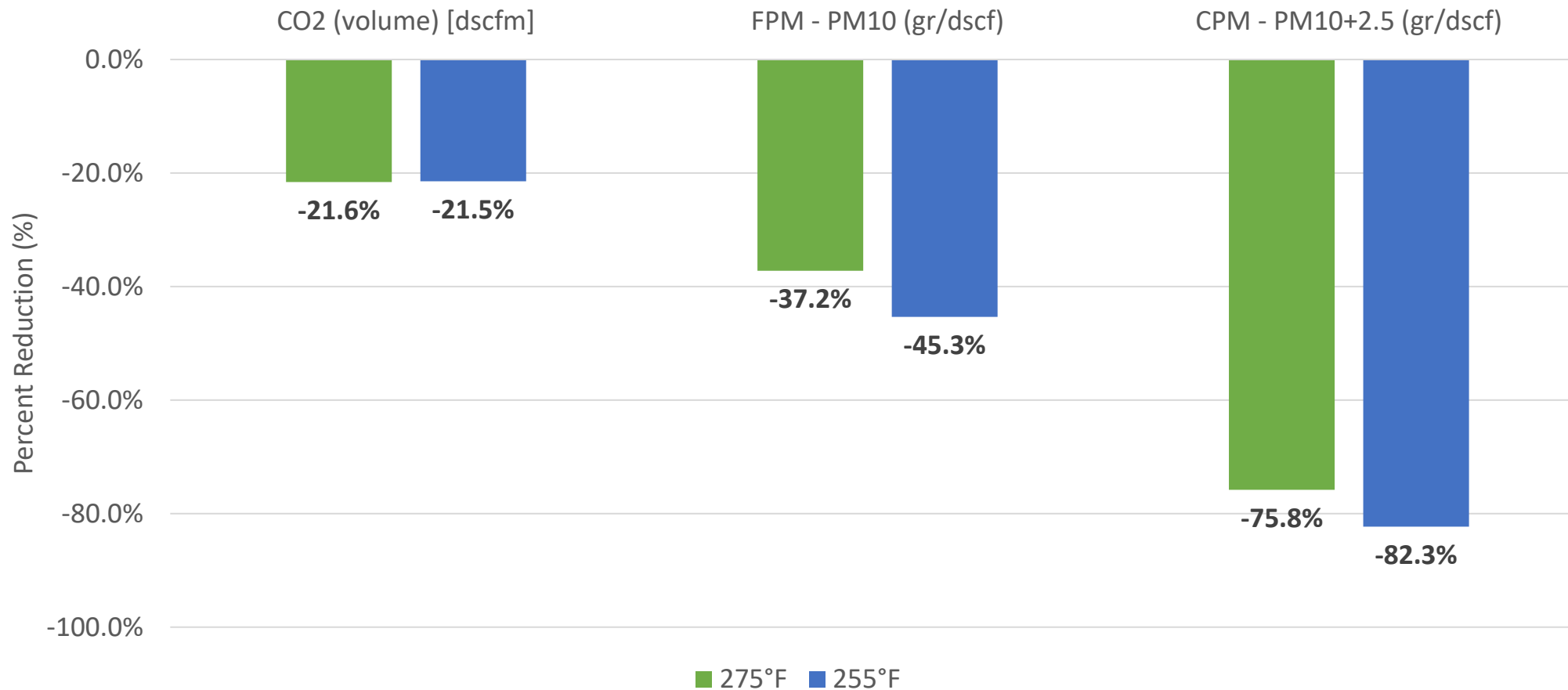
# WMA Plant Mix Data 2022

Project Details from Contractor (New York)

- 220 Tons/hr run rate
- Astec Double Barrel Green
- 20% RAP Content



Stack Testing Data – CO<sub>2</sub> and Particulate

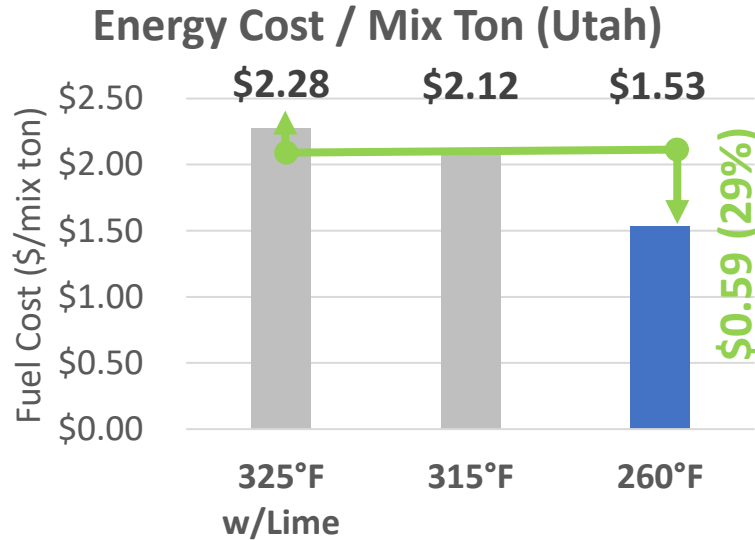


# WMA Plant Fuel Consumption Data 2022

Note: Natural gas fuel \$9.00/MMBtu assumption

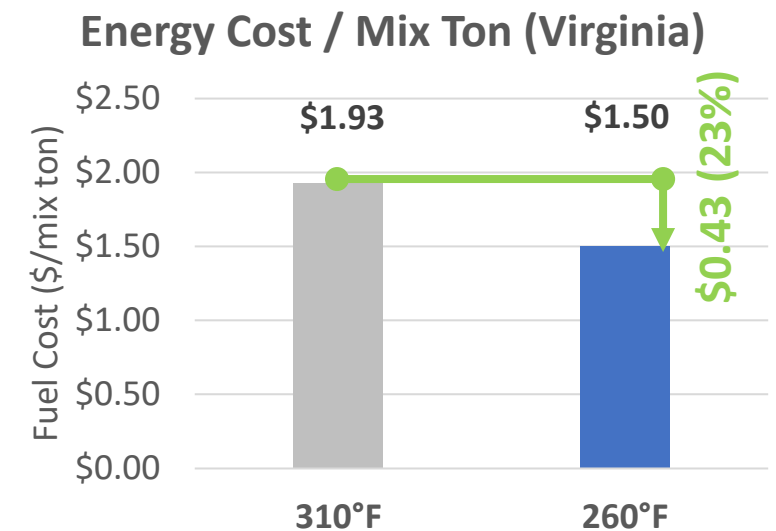
## Utah Contractor

- 360 Tons/hr
- Gencor Counter Flow
- 15% RAP
- 250k Mix Tons/yr
- **\$147.5k Savings (single plant)** running at 260°F



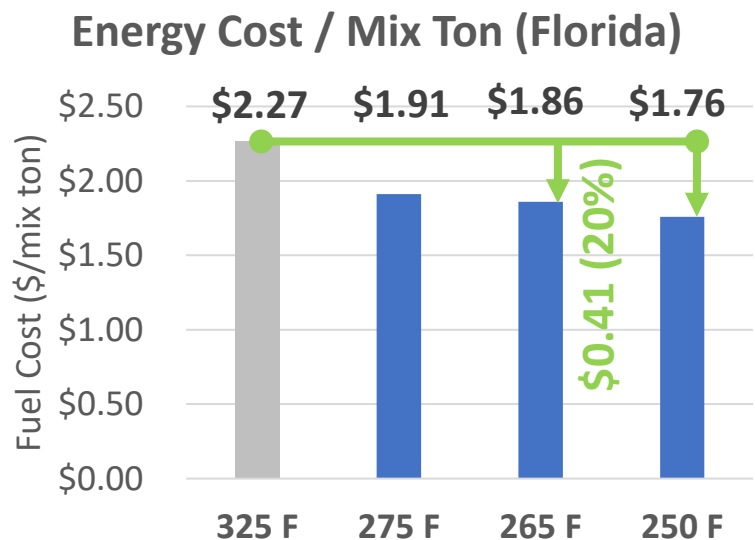
## Virginia Contractor

- 290 Tons/hr
- Astec Double Barrel
- 30% RAP Content
- 250k Mix Tons/yr
- **\$107.5k Savings (single plant)** running at 260°F



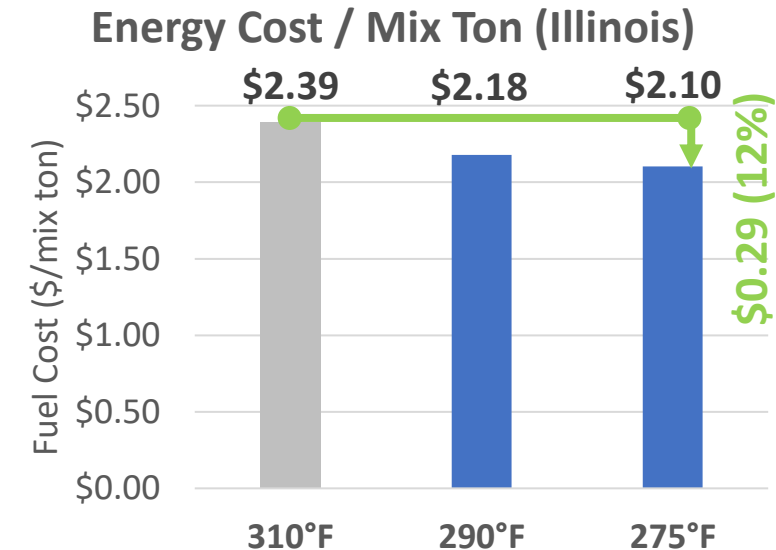
## Florida Contractor

- 200 Tons/hr
- Astec Double Barrel
- 40% RAP
- 150k Mix Tons/yr
- **\$61.5k Savings (single plant)** running at 265°F



## Illinois Contractor

- 300 Tons/hr
- Gencor Counter Flow
- 40% RAP Content
- 350k Mix Tons/yr
- **\$101.5k Savings (single plant)** running at 275°F





# Fuel Reduction Calculations

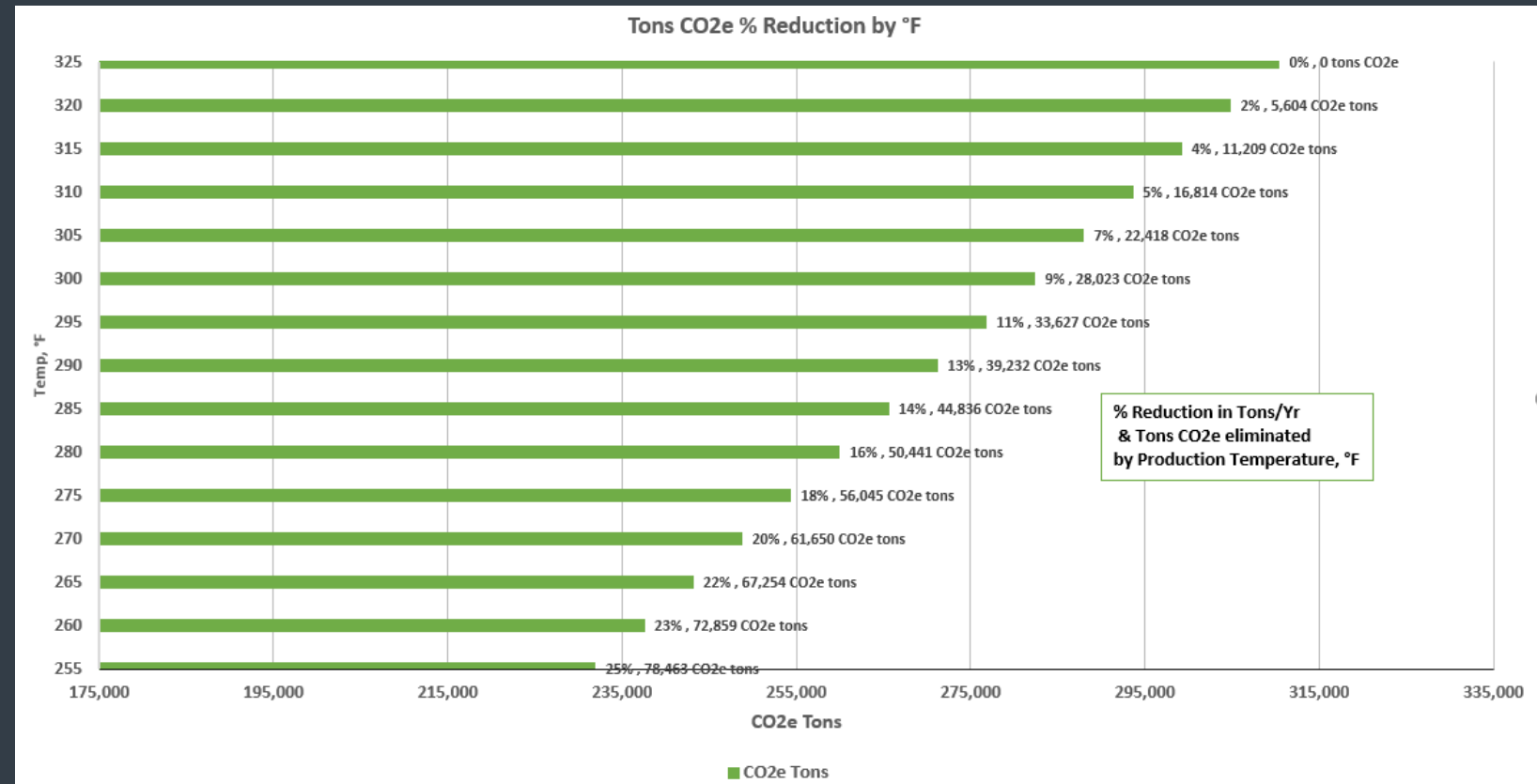
Six Projects in 2022 across USA

Average Temperature Reduction: **47.8°F**  
Average Fuel Usage Reduction: **17.8%**  
Average CO<sub>2</sub> Reduction (Stack): **22.5%**



## NY Scenario Estimate

- NY DOT produces 22 MM Tons Asphalt Mix/year (NAPA Annual Survey)
- CO<sub>2</sub>e estimated at 116.65 lbs/MMBTU Nat Gas [CO<sub>2</sub>e Value from EIA](#)
- Temperature Range for data collection 255 °F to 325°F
- Total CO<sub>2</sub> saved if all NY mix produced at 255 °F reduced from 325°F would be 78,000 tons of CO<sub>2</sub>





# What's the Path Forward



# Ingevity EPDs for Chemical WMA Additives

## Environmental Product Declaration

### Ingevity

Warm Mix Asphalt Additive, Warm Mix Asphalt Chemical Additive, Warm Mix Asphalt Chemical Package, Liquid Anti-Strip, Compaction Aid

### Product

Evotherm P25

**Self-declared core EPD based on the EN15804:2012 + A2**

*Issue Date* 7/11/2022  
*Valid until* 7/10/2027  
*Collection period* 2021

### Company

Ingevity Corporation  
5255 Virginia Avenue  
North Charleston, SC 29406 U.S.A.  
www.ingevity.com  
+1 800-458-4034

### DEMONSTRATION OF VERIFICATION

EN15804:2012+A2 serves as core PCR  
Third party verification of the declaration, according to ISO 14025

- ☒ Internal Third party verifier
- ☒ External The Right Environmental Ltd.

## Environmental Product Declaration

### Ingevity

Warm Mix Asphalt Additive, Warm Mix Asphalt Chemical Additive, Warm Mix Asphalt Chemical Package, Liquid Anti-Strip, Compaction Aid

### Product

Evotherm M1

**Self-declared core EPD based on the EN15804:2012 + A2**

*Issue Date* 12/2/2021  
*Valid until* 12/1/2026  
*Collection period* 2020

### Company

Ingevity Corporation  
5255 Virginia Avenue  
North Charleston, SC 29406 U.S.A.  
www.ingevity.com  
+1 800-458-4034

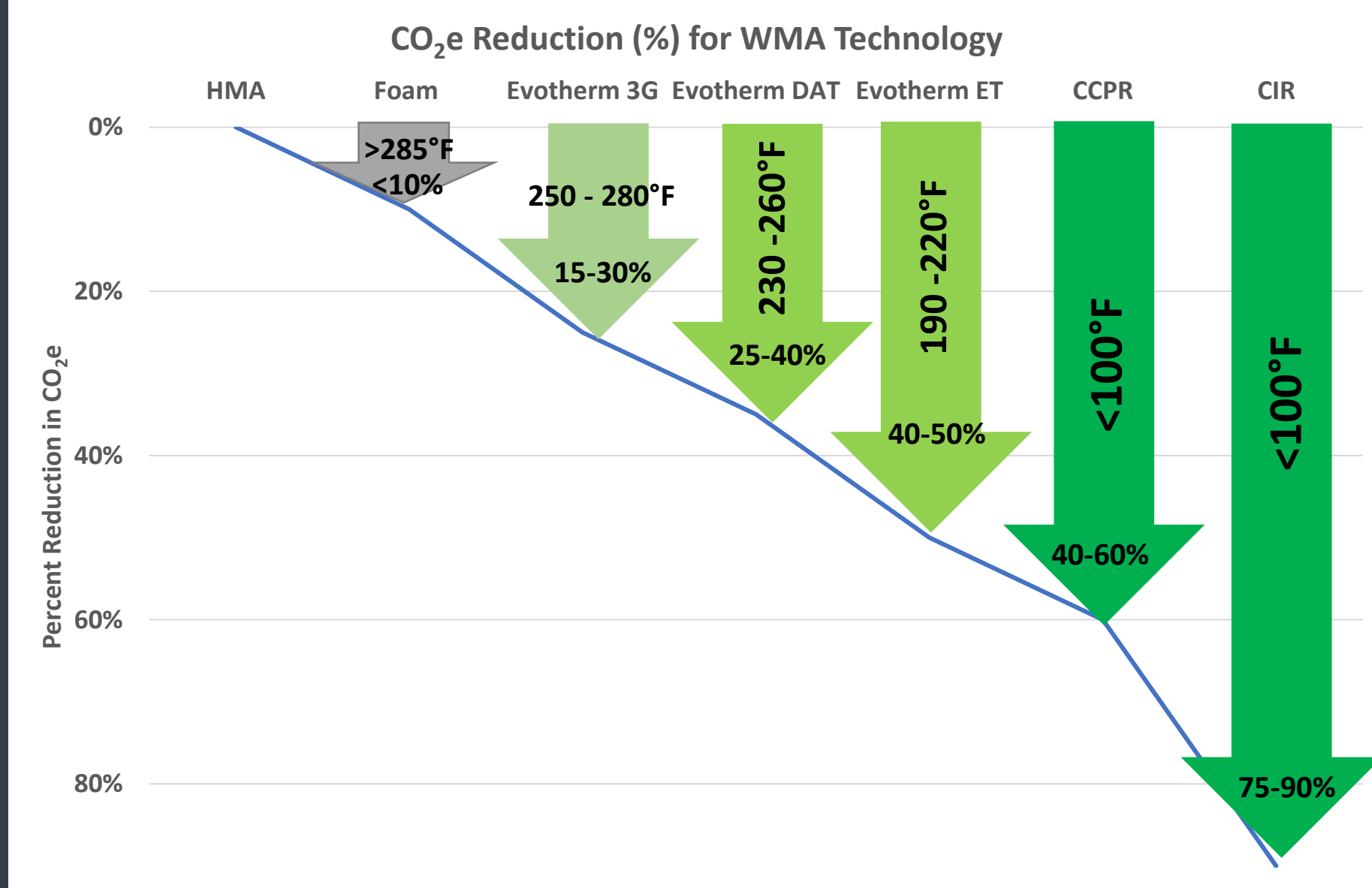
### DEMONSTRATION OF VERIFICATION

EN15804:2012+A2 serves as core PCR  
Third party verification of the declaration, according to ISO 14025

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# CO<sub>2</sub> Reduction – Path to Zero



# Agency Options

## Incentive Specifications

\$1 /ton Bonus < 290°  
Production Temperature

\$2/ton Bonus < 270°  
Production Temperature

## WMA Temperature Specifications

Road Owner Specifies Max  
Production Temperature

## Line Item Pay

DOT pays for WMA as a  
separate line item.

Similar model to asphalt  
binder in SC or LAS in TN



# True WMA Is Good For Our...

- People 
- Planet 
- Performance 
- Profitability 



# Thank you!

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