

# How Should We Use EPDs?

**NEAUPG 2024  
Springfield, MA  
October 16, 2024**



# Sustainability – Drive to Net Zero Carbon Footprint

- Owner agencies are beginning to require EPDs to collect data on environmental impact of asphalt mixes
- The goal for everyone is to reduce carbon footprint
- Easiest way for contractors to lower EPD numbers is to use less virgin asphalt and add more RAP
- Evaluating EPD from cradle to gate does not consider performance of the pavement
- How will agencies use this data?





# *The NCAT Test Track*



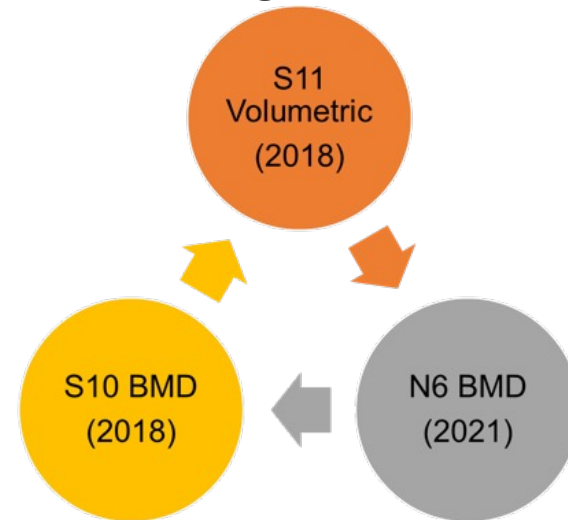
# The NCAT Test Track

- 46 Test Sections, 200 ft. each
- 5 trucks each pulling 3 heavily loaded trailers make 400 laps/day
- Test sections are evaluated continuously over 3-year cycles
- 2024 begins our 9<sup>th</sup> cycle



# TxDOT BMD Experiment at the NCAT Test Track

- Field performance comparison of asphalt mixes designed with volumetric vs. BMD approaches
  - 2.5 in. mill-and-inlay
  - Underlying pavement 15-20% lane area cracking



# TxDOT BMD Experiment Mix Designs

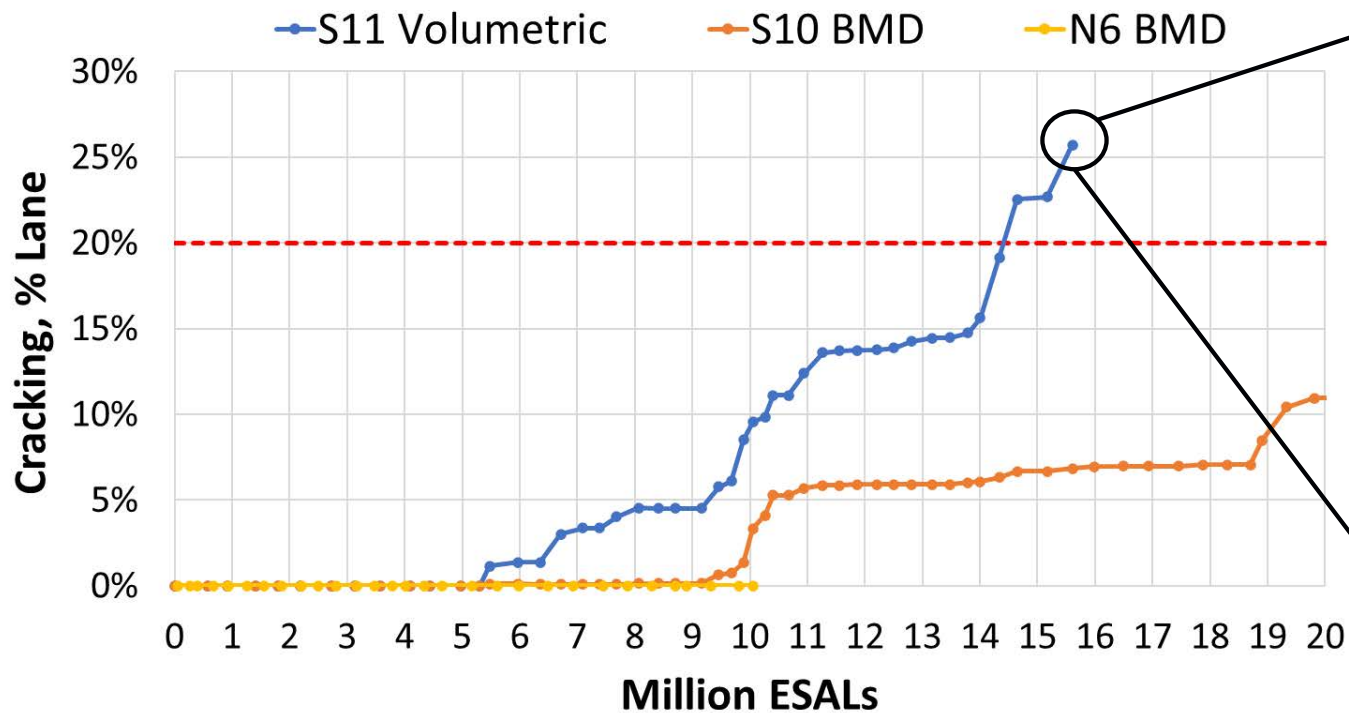
- TxDOT 12.5mm SP-C surface mix – “volumetric”
- PG 70-22 SBS binder in all three test sections
- BMD approach A: Volumetric Design with Performance Verification

Mix Design	S11 Volumetric (2018)	S10 BMD (2018)	N6 BMD (2021)
Total Binder Content	4.7	5.5	5.3
RAP Binder Replacement	20	20	19
Air Voids (50 Gyration)	4.0	4.0	4.0
VMA*	15.0	16.6	16.4
$V_{be}$ *	11.0	12.6	12.4
VFA*	73	76	76

\* based on Gse

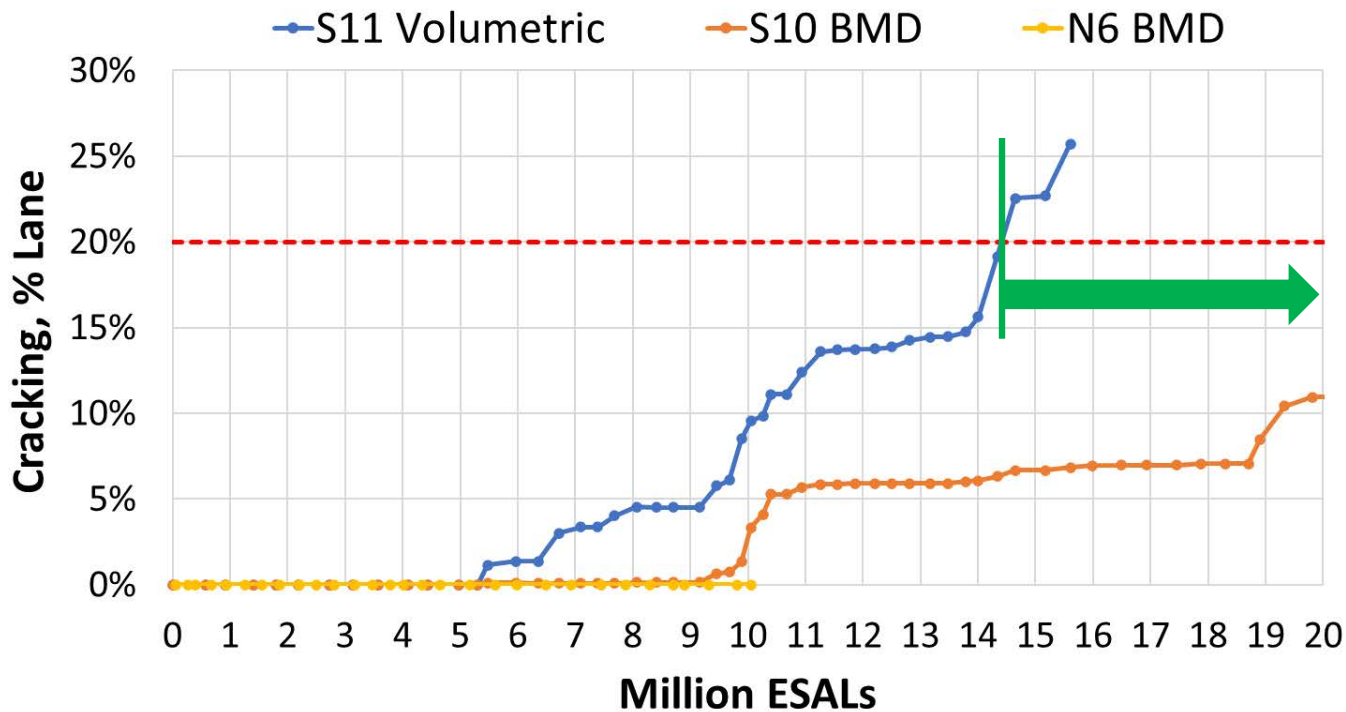


# TxDOT BMD Field Cracking Results



Cracking performance: S10 > S11

# TxDOT BMD Field Cracking Results



BMD overlay life extension > 5.5 MESAIs (>1.3 times longer)

Cracking performance: S10 > S11



# LCCA for Texas Mix Comparison

- TxDOT LCCA Policy

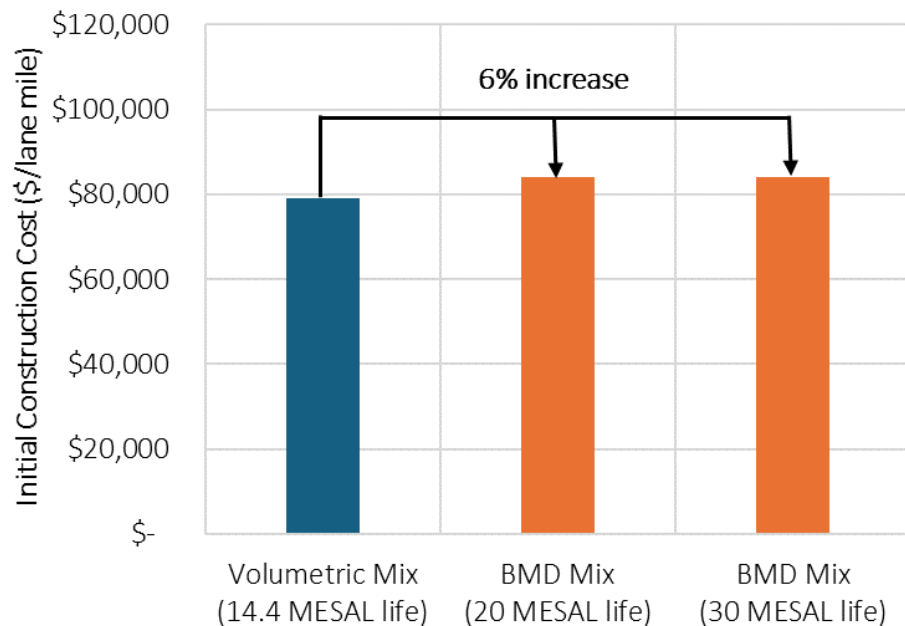
- 40-year Analysis Period
- Discount rate: 3.72%
- 12-year performance period for volumetric mix
- Volumetric mix cost: \$80/ton per TxDOT bid price database
- BMD mix cost: \$84.8/ton = \$80/ton + 0.64% more virgin PG 70-22 binder × \$750/ton

## M&R Schedule for LCCA and LCA, TxDOT Ex.

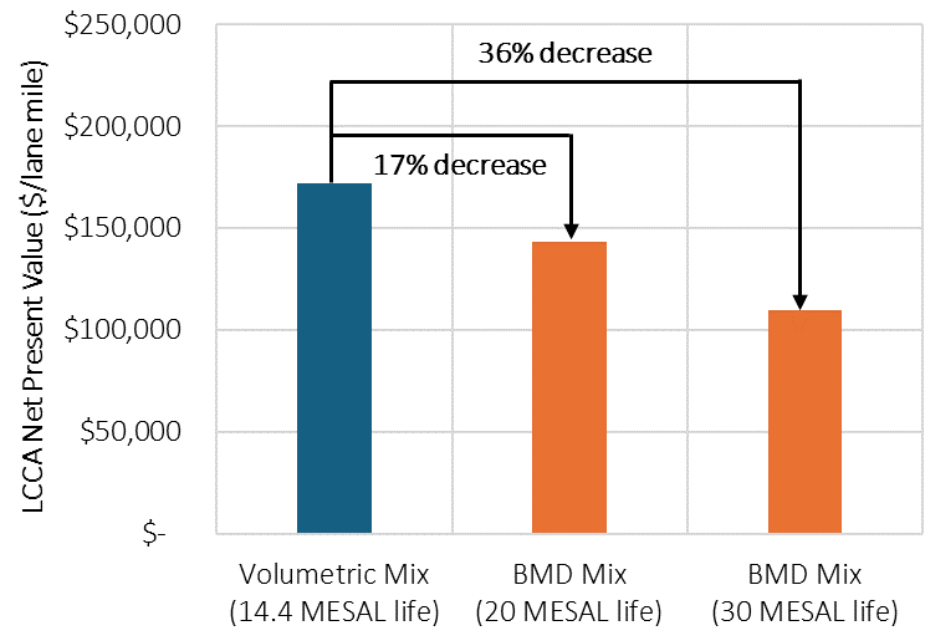
Year	Volumetric Mix (14.4 MESAL Life)	BMD Mix (20 MESAL Life)	BMD Mix (30 MESAL Life)
0	Initial construction	Initial construction	Initial construction
12	2.5" mill & fill		
16.6		2.5" mill & fill	
24	2.5" mill & fill		
25			2.5" mill & fill
33.2		2.5" mill & fill	
36	2.5" mill & fill		
40	End of analysis period	End of analysis period	End of analysis period
Remaining Life (yrs.)	8.0	9.8	10.0

# Life Cycle Cost Analysis Results

## Initial Construction Cost Comparison



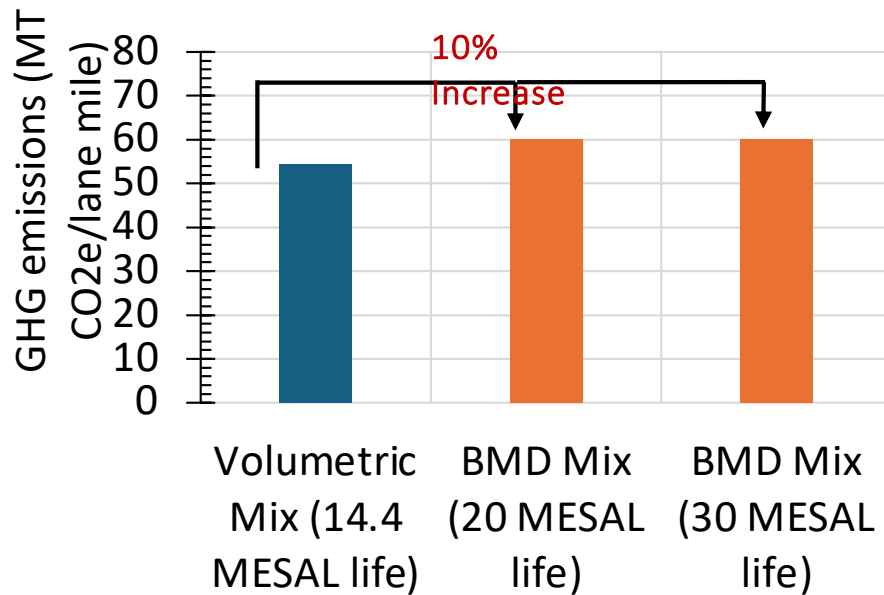
## LCCA Net Present Value Comparison



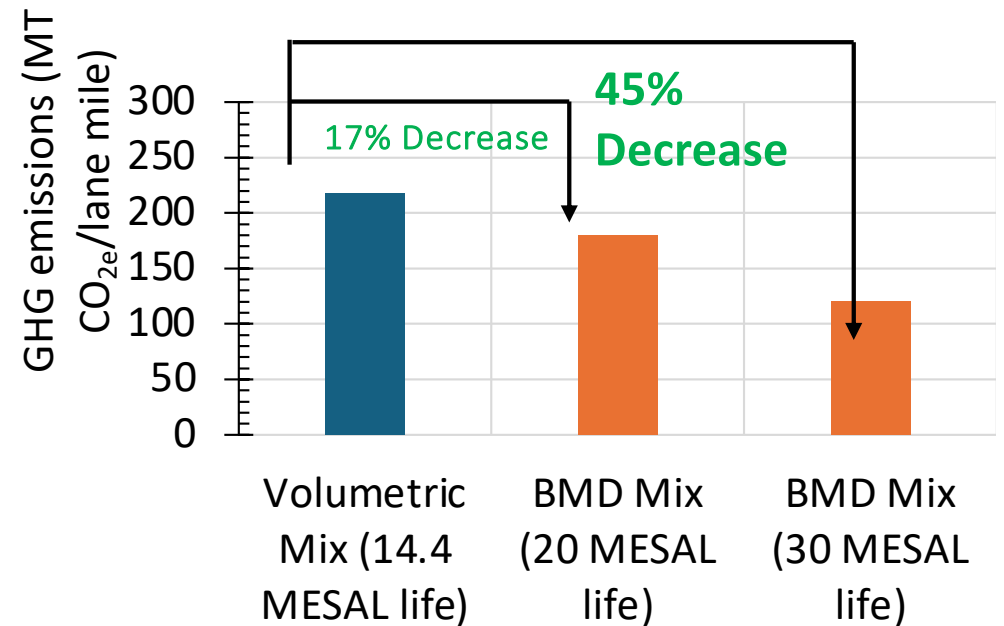
Functional Unit – One Lane mile

# Life Cycle Assessment Results

## Initial Construction (Cradle-to-Constructed)



## Full Life Cycle (Cradle-to-Grave)



Functional Unit – One Lane mile

MT = Metric ton

An aerial photograph of a two-lane asphalt road winding through a dense forest. The trees are mostly green, with some showing autumnal colors of orange and red. A large truck is visible on the road, moving away from the viewer. The road has a yellow line on the left side and a white dashed line in the center. The overall scene is a natural, wooded area.

## Example #2

- 2015-2021 NCAT Cracking Group Experiment
- Correlation of BMD Cracking Tests to Field Performance

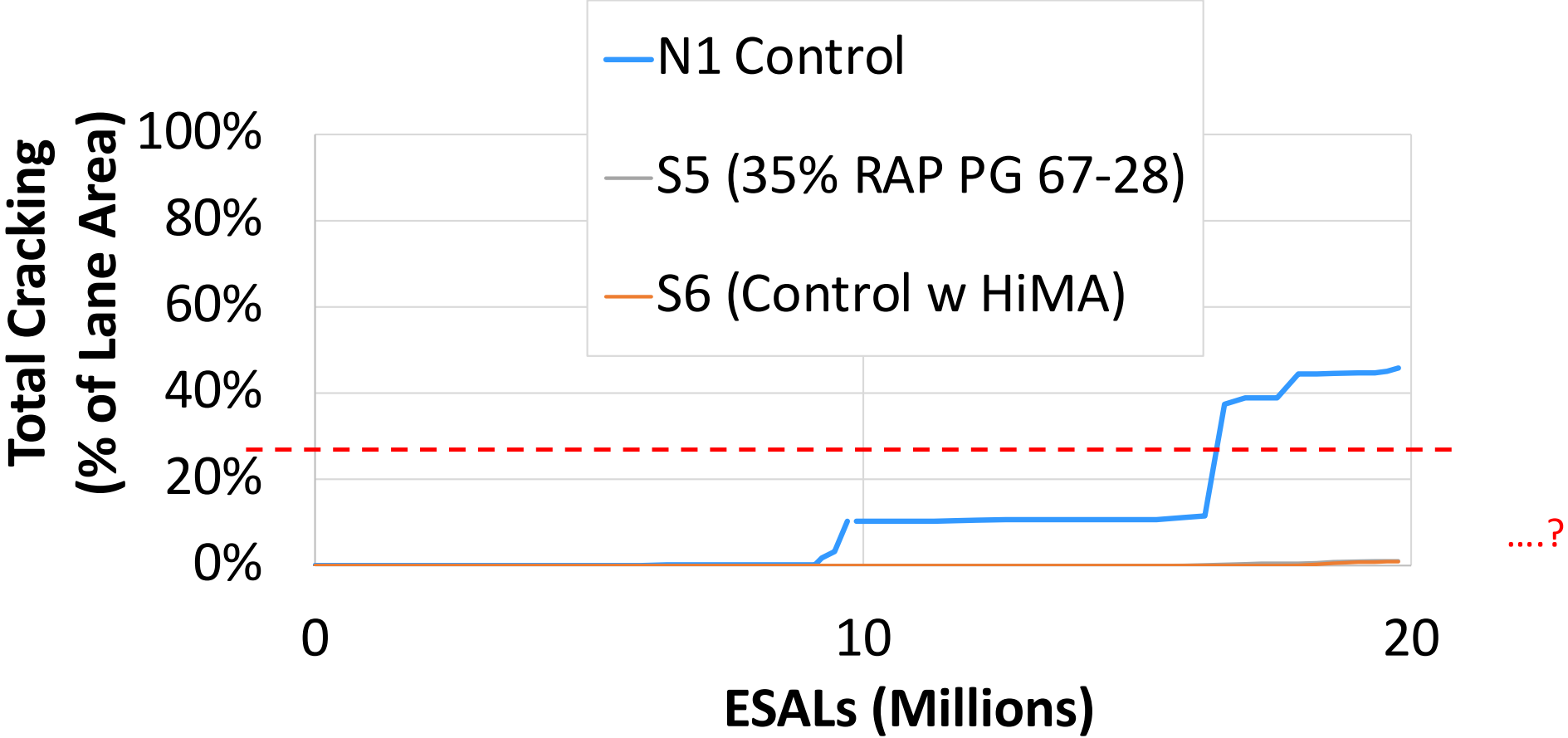
# NCAT Cracking Group Experiment – QC Results

Section	Description	NMAS	Eff. Binder Content (%)	Air Voids (%)	VMA (%)	As-Const. Density (%G <sub>mm</sub> )	Recovered Binder Cont. Grade
N1	20% RAP (Control)	9.5 mm	4.7	3.8	14.7	93.6	88.6 -16.6
S5	35% RAP, PG 67-28	9.5 mm	5.1	3.2	15.1	92.2	82.8 -23.0
S6	Control w HiMA	9.5 mm	5.0	3.1	14.7	91.8	101.4 -21.5

# Cracking Group Experiment: BMD Cracking Test Results & Field Performance

Section	Description	Critically Aged Test Results					% Lane Area Cracking
		CT <sub>index</sub>	Flexibility Index	OT- $\beta$	NCAT-OT $\beta$	$S_{app}$	Feb. 2021 20 MESALs
N1	20% RAP (Control)	8.8	0.6	2.08	<b>0.50</b>	18.6	44.5
S5	35% RAP PG 67-28	16.3	1.8	1.54	<b>0.33</b>	45.3	1.1
S6	Control w HiMA	18.7	3.8	1.07	<b>0.27</b>	48.0	0.9

# Cracking Group Field Performance





# LCCA for Cracking Group Mix Comparison

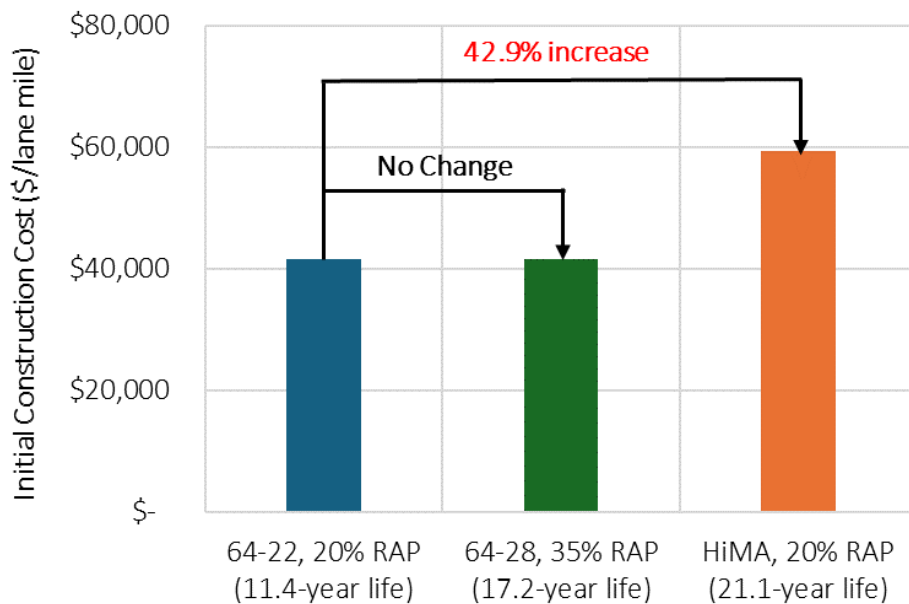
- NCAT LCCA recommendations for ALDOT
  - 40-year Analysis Period
  - Discount rate: 4.0%
  - Performance Periods
    - Control mix: 1 yr. on TT = 3.5 yrs on I-85 = 11.4 years
    - 35% RAP mix = ratio of NCAT-OT  $\beta = 1.51 = 17.2$  years
    - HiMA mix = ratio of NCAT-OT  $\beta = 1.85 = 21.1$  years
  - Mix Costs
    - Volumetric mix: \$70/ton per ALDOT bid price database
    - 35% RAP mix: \$70/ton (PMA binder & RAP savings wash)
    - HiMA mix: \$100/ton (estimate)

# Cracking Group Assumed LCCA & LCA M&R Schedule

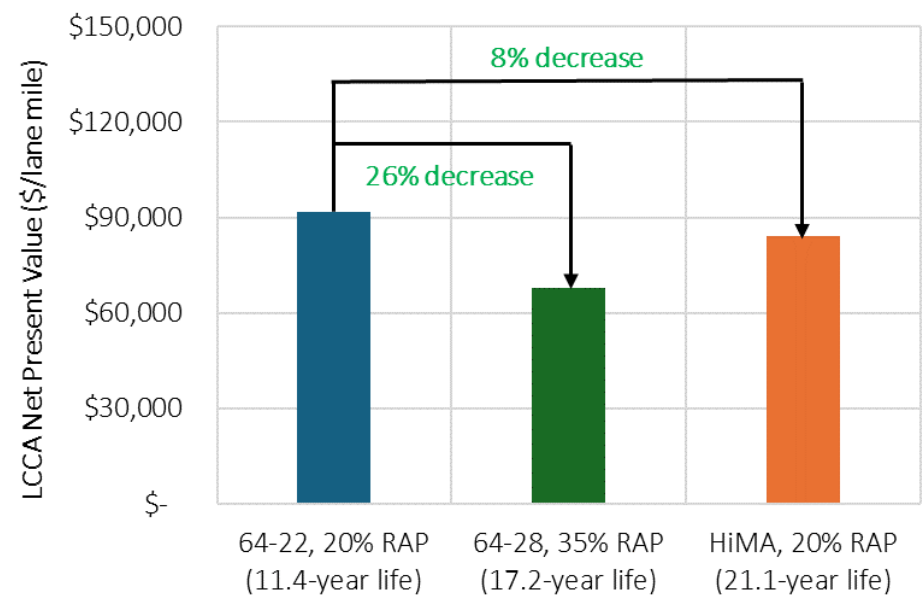
Year	64-22 w/ 20% RAP (11.4 Year Life)	64-28 w/ 35% RAP (17.2 Year Life)	HiMA w/ 20% RAP (21.1 Year Life)
0	Initial construction	Initial construction	Initial construction
11.4	1.5" mill & fill		
17.2		1.5" mill & fill	
21.1			1.5" mill & fill
22.8	1.5" mill & fill		
34.2	1.5" mill & fill		
34.4		1.5" mill & fill	
40	End of analysis period	End of analysis period	End of analysis period
Remaining Life (yrs)	5.6	11.6	2.2

# Life Cycle Cost Analysis Results

## Initial Construction Cost Comparison

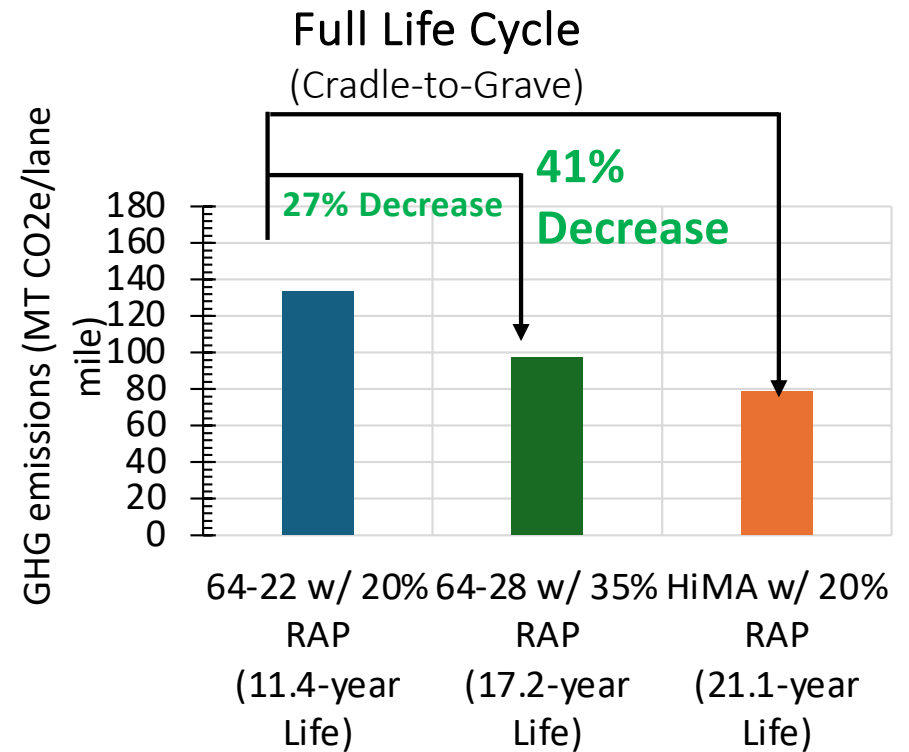
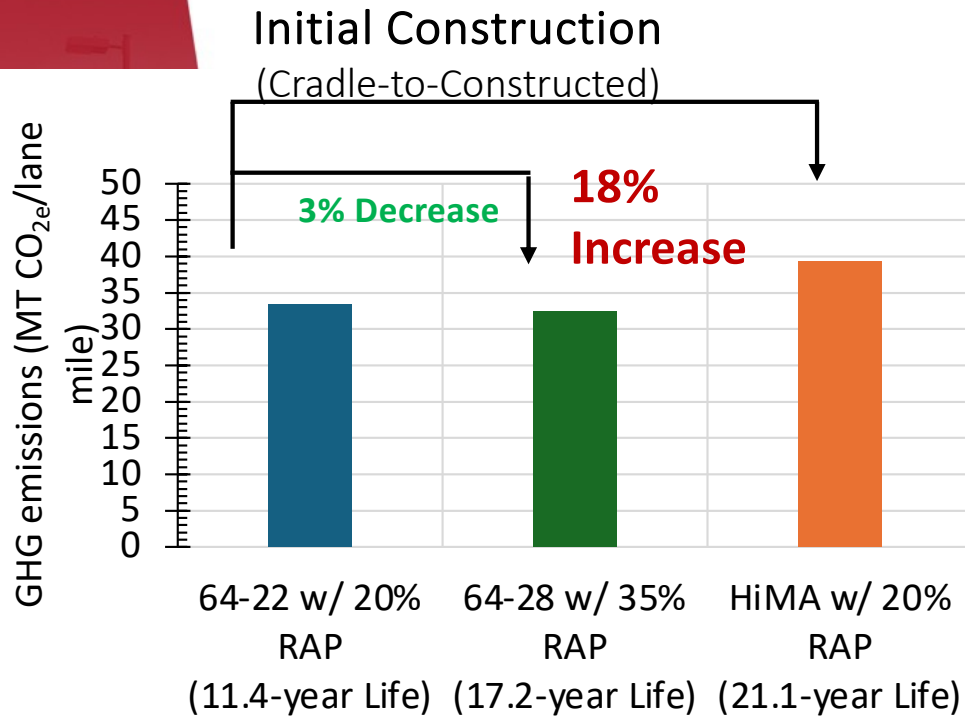


## LCCA Net Present Value Comparison



Functional Unit – One Lane mile

# Life Cycle Assessment Results



Functional Unit – One Lane mile

# Summary

- Our first expectation for BMD should be better field performance and longer pavement lives. The Test Track is giving us a glimpse of that.
- Initial cost of BMD mixes will likely be higher
- Cradle to Gate EPD may not show best mix choice
- How are state agencies going to handle EPD data?

