

Comparison of CIR With Mill & Fill and Two Course HMA Overlay

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CIR IN NEW YORK STATE

**THE NEW YORK STATE ENERGY
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CIR IN NEW YORK STATE

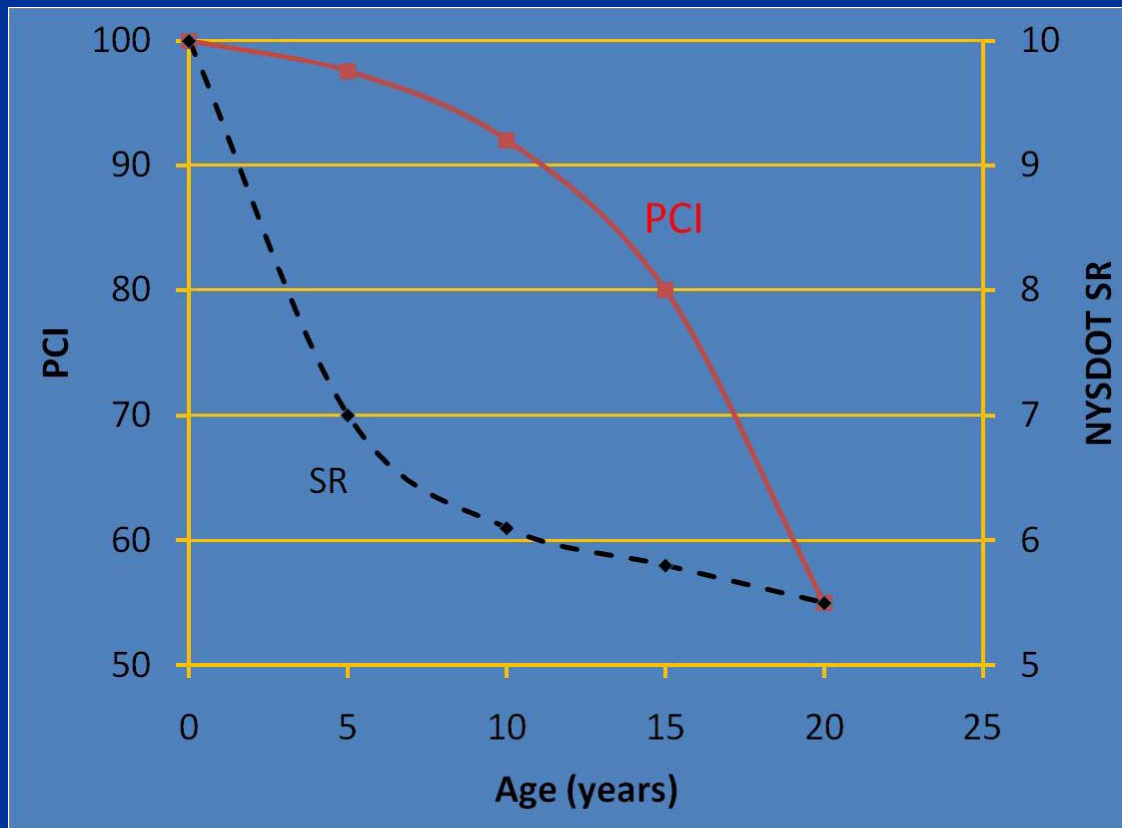
- Literature Review
- Survey State Practice
- *Analysis of State Sufficiency Rating Database*
- *Comparison of PCI for CIR, MF & TCO*
- Environmental Impact CIR, MF & TCO
- Best Practice Guide

Analysis of State Sufficiency Rating Database

- 2008 New York Pavement Management Group Sufficiency Ratings (SR) Database
- Looked at CIR Only
- 163 CIR Projects
- Constructed Between 1992-2008
- Consisted of 756 Miles Pavement
- 604 Segments, 1240 SR Data Points

SR Scale

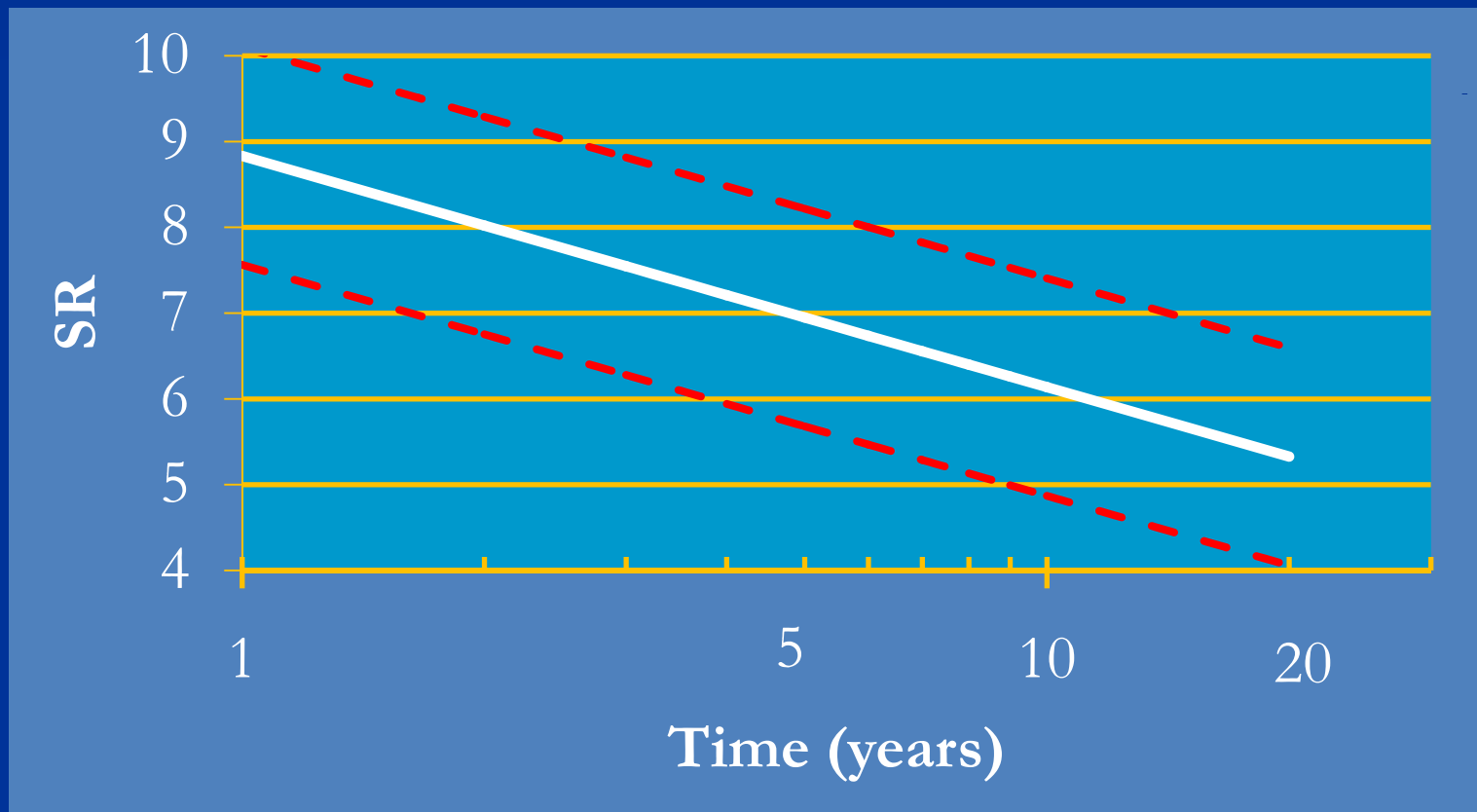
- Rating from 10 to 0 with 10 Being Best
- Based on Surface Distress, SR of 6 Used to Indicate Corrective Action Required



SR has Different Deterioration Curve than Traditional PCI Curves

CIR Treatment Life

Average Life 11 Years, Upper & Lower 90% Confidence Limits 30 & 4 Years, Respectively.



SR Database Analysis

- Performed Analysis of Variance on Subgroups of Data to Determine Effect of:
 - AADT
 - ESALs
 - Base Thickness
 - Base + Subbase Thickness
 - Region (Climate)
 - Rehabilitation SR
- Means with Same Grouping Letter Not Statistically Different

Higher Traffic = Longer life

Sub-Group	Ndata Points	SR 6 Intercept (yrs)	ANOVA Grouping
AADT			
< 2000	487	11.08	A
2 k – 4 k	432	9.47	A
> 4,000	321	13.27	B
ESALs			
< 50,000	692	10.67	A
50k – 100k	289	12.98	B
> 100,000	259	14.11	B

Thicker Base = Longer life

Sub-Group	Ndata Points	SR 6 Intercept (yrs)	ANOVA Grouping
Base Thickness			
< 4.5"	232	10.64	A
4.5 – 5.5"	413	11.26	A
> 5.5"	437	11.29	B
Base + Subbase Thickness			
< 9"	332	10.77	A
9 – 11"	627	10.87	A B
> 11"	123	15.02	B

Better Condition = Longer life

Sub-Group	Ndata Points	SR 6 Intercept (yrs)	ANOVA Grouping
Region (Climate)			
1,2 & 7 Northeast	765	11.17	A
All Others	475	11.02	A
SR Prior to Rehabilitation			
< 5.5	350	10.45	A
5.5 – 6.5	740	10.35	A
> 6.5	150	17.00	B

ASTM D 6433 Comparison

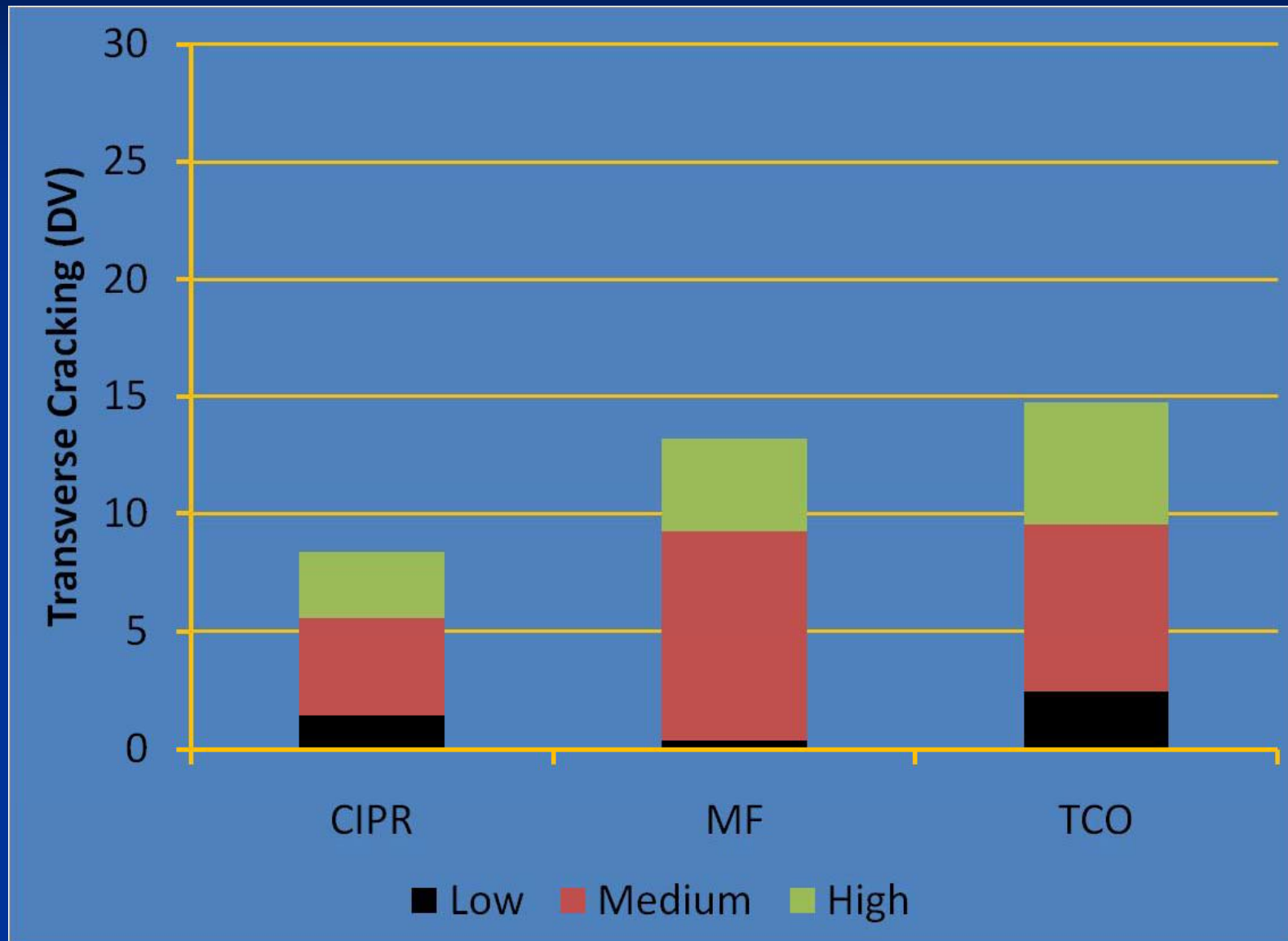
- ASTM D 6433 quantifies pavement condition using a Pavement Condition Index (PCI) based on surface distress.
- According to ASTM D 6433, the observed surface distress indicates structural integrity and operational condition of the pavement.
- PCI Ranges from 0 to 100 with 0 being the worst possible condition and 100 the best possible condition.

Pavements Evaluated

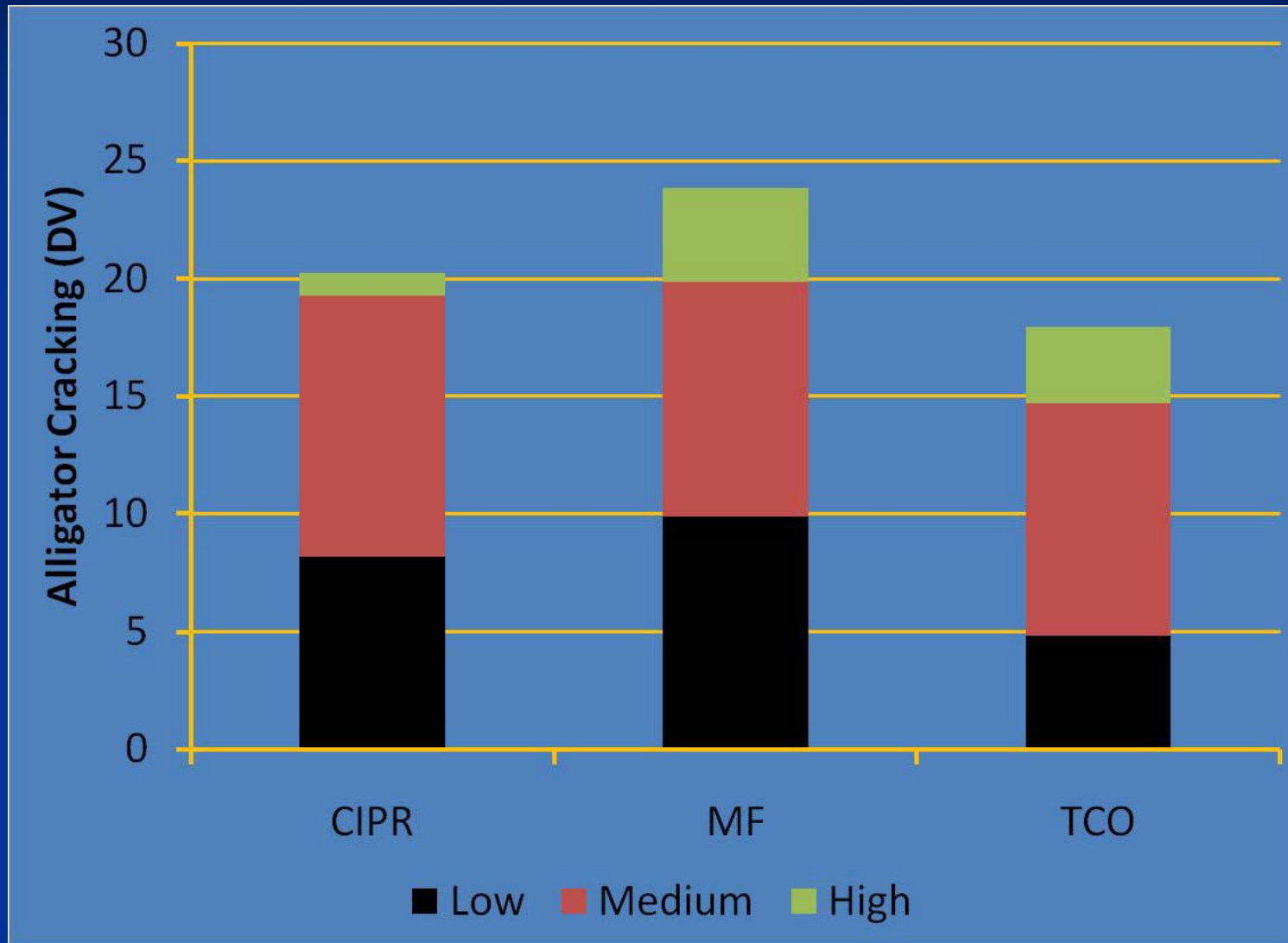
	CIR	Mill & Fill (MF)	2 Lifts HMA (TCO)
Miles	37.7	17.6	31.5
AADT	1500-4820	1810-5210	2070-6390
Age	5-15	6-15	8-20



Transverse Cracking



Fatigue (Alligator) Cracking



Non-Load Associated Distress

- Rank From 1 to 3 Based on Total Deduct Value, 1 = Lowest Deduct Value
- CIR Least Amount Non-Load Associated Distress

Distress	CIR	MF	TCO	Stat. Diff.
Longitudinal Cr.	2	1	3	No
Transverse Cr.	1	2	3	No
Block Cr.	2	1	3	No
Bleeding	1	3	1	No
Raveling	1	2	3	No
Total	7	9	13	

Load Associated Distress

- Rank From 1 to 3 Based on Total Deduct Value, 1 = Lowest Deduct Value
- MF Least Amount Load Associated Distress

Distress	CIR	MF	TCO	Stat. Diff.
Alligator Cr.	2	3	1	No
Rutting	3	1	2	No
Edge Cr.	2	1	3	No
Patching	2	1	3	No
Potholes	3	1	2	No
Total	12	7	11	

Environmental Effects

- Pavement Life-Cycle Assessment Tool for Environmental and Economic Effects (PaLATE)
- PaLATE is a Life Cycle Environmental Analysis or Hybrid Model that combines Process-Based Environmental Analysis with an Economic Input-Output Life-Cycle Assessment Model, providing a more Global perspective than traditional Process-Based Environmental Analysis.

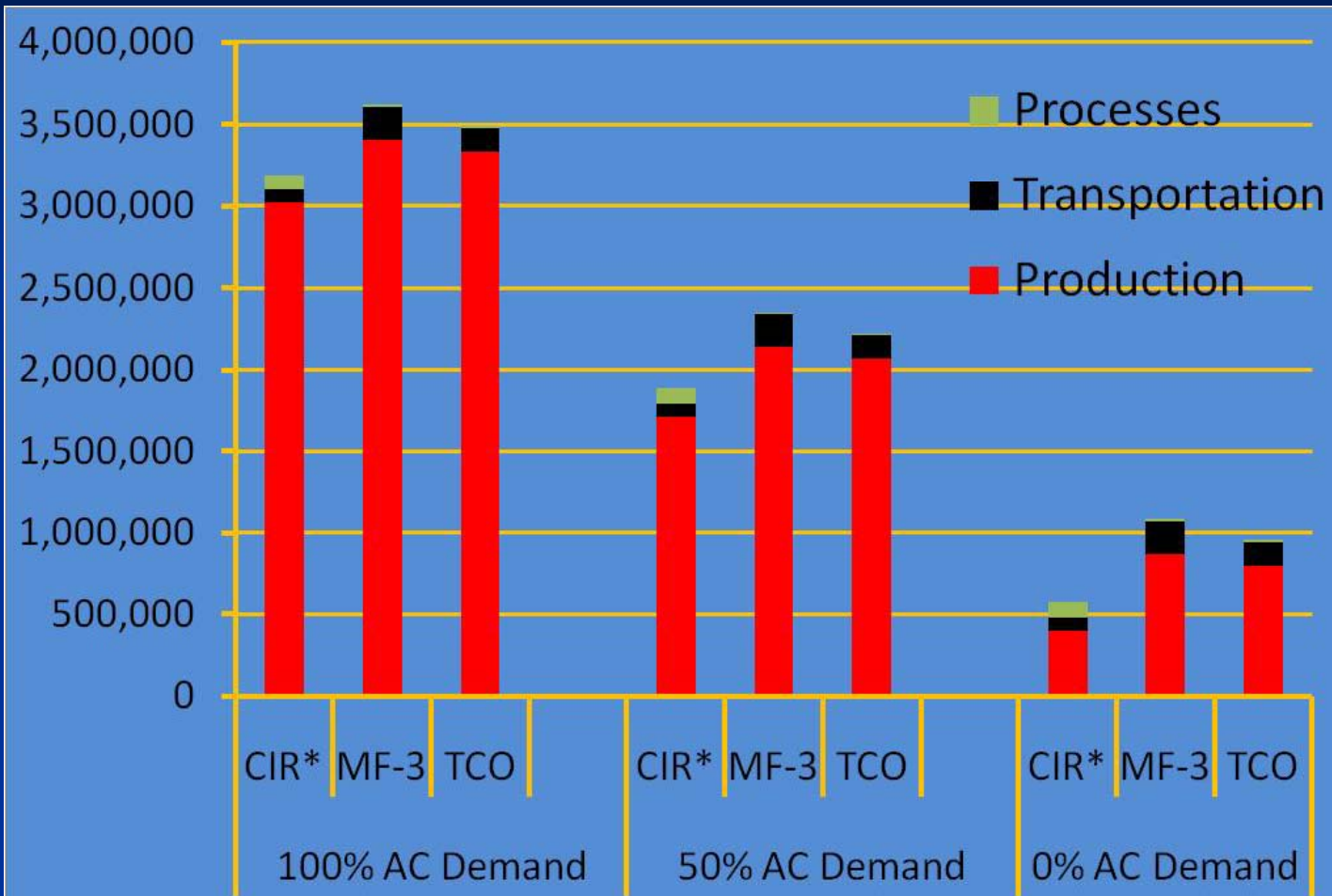
Environmental Effects

- Life Cycle Environmental Analysis is state-of-the-art work and there are well documented issues with PaLATE and Asphalt Production Impacts
- We looked at the following:
 - 100% Asphalt Demand (PaLATE output)
 - 0% Asphalt Demand (process based)
 - 50% Asphalt Demand (to show linear relationship)

Pavement Section Evaluated

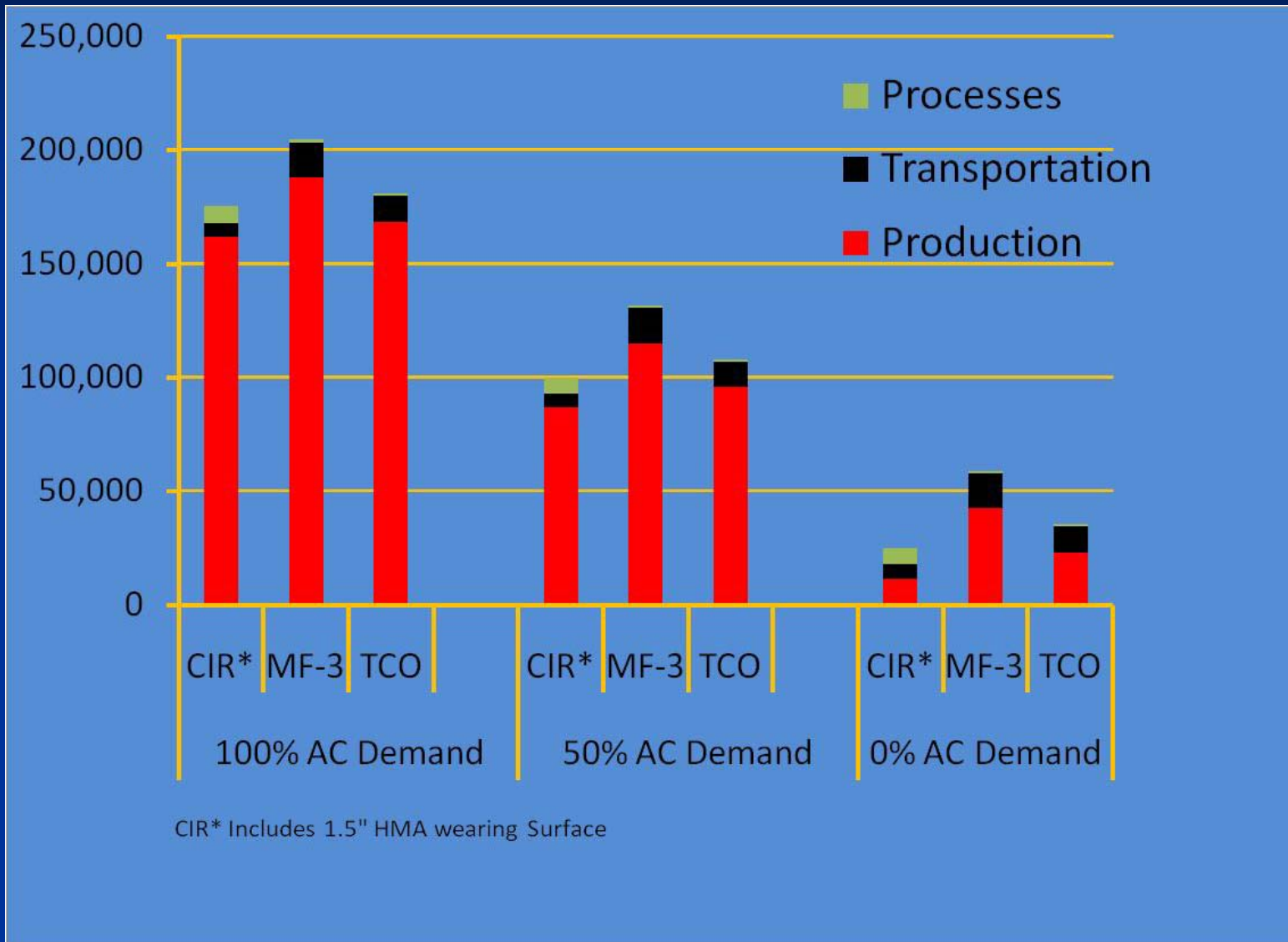
- 1-mile section of a 24-foot wide pavement
- 4" CIR (CIR) with 1.5" HMA Overlay
- Mill 3" replace 3" HMA (MF-3)
- 3 " HMA placed two lifts (TCO)
- 100 miles refinery/terminal to HMA plant
- 25 miles from plant to project
- 25 miles from quarry to plant
- Shoulders excluded but could be required with two course HMA overlay

Energy (MJ/mile)



CIR* Includes 1.5" HMA wearing Surface

Greenhouse Gas (kg/mile)



Conclusions

- Conventional Wisdom which limits CIR use to low AADT and low truck traffic may be misleading. (The data generated in this study supports the opposite conclusion).
- CIR pavements last longer if applied on pavements with:
 - Higher AADT and ESALs
 - Thicker bases and subbases.

Conclusions

- The greater the deterioration of the pavement at time of CIR rehabilitation the lower the expected service life.
- The primary field performance factor is not traffic but pavement support structure.
- When CIR is used on better-designed pavements that have thicker supporting bases, performance will benefit and service life will be extended.

Conclusions

- There was no statistical difference in performance between CIR, MF or TCO, as measured by ASTM D 6433 PCI.
- CIR had less non-load associated distress compared to MF or TCO.
- CIR has a lower environmental impact than MF or TCO.

Thank You

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