

# ***History, Performance and Benefits of Cold Recycling***

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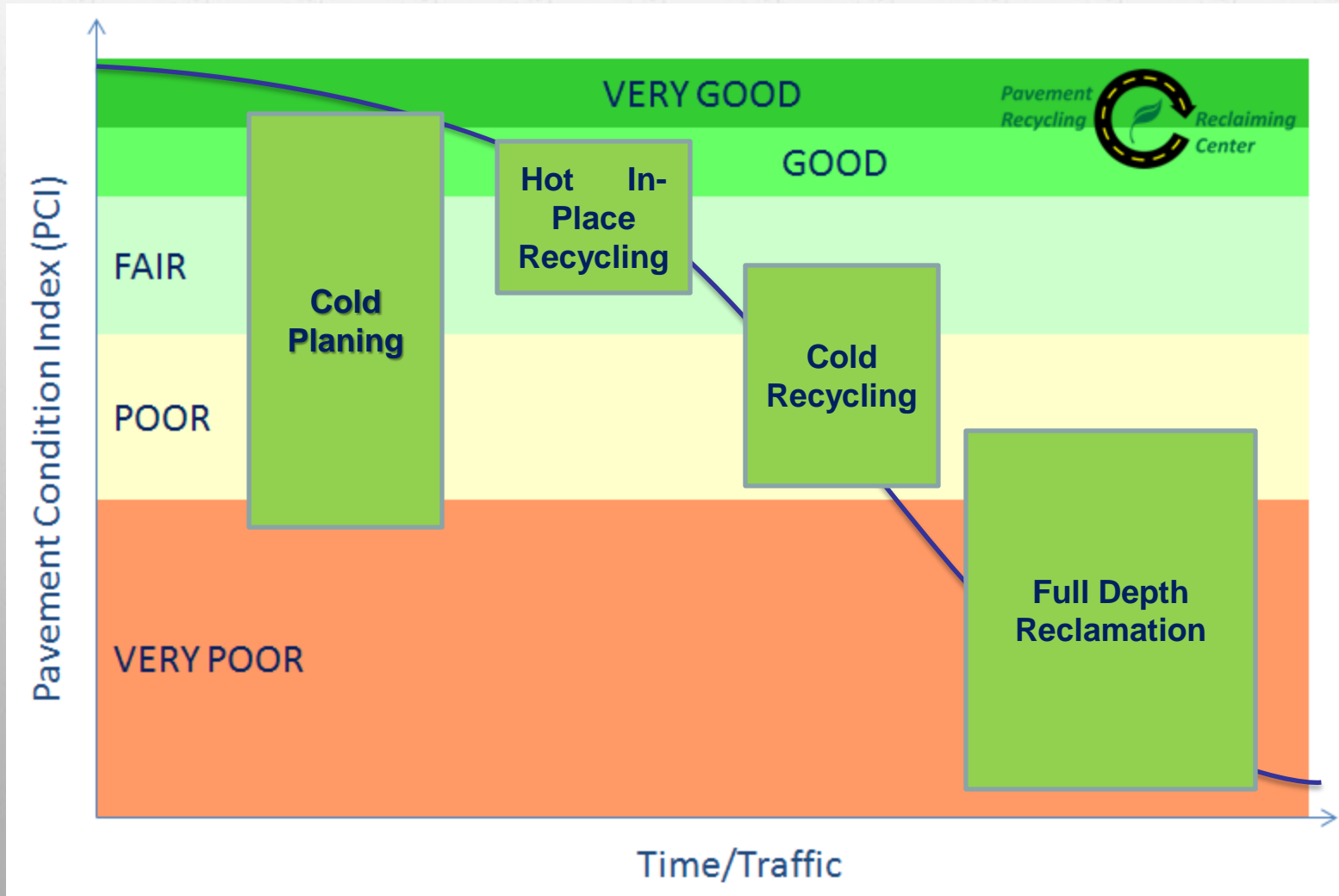
**Asphalt Recycling & Reclaiming Assoc.**

# ***COLD IN-PLACE RECYCLING DEFINITION***

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**Cold In-Place Recycling (CIR)  
Involves Milling the Existing Asphalt  
Surfacing to a Specified Depth, Sizing  
the Milled Material, Adding Various  
Additives (Emulsion, Foam, Lime  
Slurry, Cement), Mixing the RAP and  
Additives, Laying and Compacting  
the Recycled Material.**

# Pavement Management



# Recycling and Reclaiming Strategies and Their Effects

M&R Category	Strategy	Method:	CP	HIR	CR	FDR
<b>Construction</b>	New					
	Reconstruction		✓			✓
<b>Rehabilitation</b>	Major (Heavy)		✓		✓*	✓
	Structural Overlay		✓	✓*	✓*	✓*
<b>Maintenance</b>	Minor (Light)	} <b>Pavement Preservation</b>	✓	✓	✓	
	Preventive		✓	✓	✓	
	Routine		✓			
	Corrective (Reactive)		✓	✓	✓	
	Catastrophic		✓			

- With HMA Overlay
- CR: CIR & CCPR

# ***EARLY CIR HISTORY***

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- ❖ **First Attempts At The “Train” Process Were In The Early 80’s In California And Arizona**
- ❖ **In Mid 80’s, Other States Such As Oregon And New Mexico Began Using The Process**
- ❖ **Kansas and New York Began To Use The Process As Well**
- ❖ **CIR is Routine Procedure for Many States**

# ***IMPROVEMENTS TO THE PROCESS***

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- ❖ **Early Research by Gary Hicks and Gordon Mckeen Was Instrumental In the Growth of the Process**
- ❖ **ARRA Contractors Worked Diligently to Craft Ever Improving Specifications for Agencies**
- ❖ **Improvements In Equipment and Additives Have Contributed to a Better Quality Product**



# *Multi-Unit Trains*

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- ▶ **Most Original Work Performed with Long Trains**



# *Classes of CIR*

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- ▶ **Multi-Unit Train:** Pulverize, Screen, Crush, Add Recycling Agent Based on RAP Weight & Mix in Pugmill
- ▶ **Two-Unit Train:** Pulverize, Add Recycling Agent Based on RAP Weight & Mix in Pugmill
- ▶ **Single Unit Train:** Pulverize, Add Recycling Agent –All in Cutting Chamber of Milling Machine



# *Modern Multi-Unit Train*



# ***Two-Unit Train***

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# *Single Unit Train*

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# *Placement/Laydown*

- ▶ Mixture is deposited in windrow and placed in paver with pick-up device or deposited directly into paver



# ***CIR – Placement & Compaction***

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- ▶ **CIR is harder to compact than HMA (more viscous)**
- ▶ **Heavy Pneumatic roller(s)**
- ▶ **Vibratory Steel Wheeled Roller(s)**





# *Wearing Surface*

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- **Chip Seal**
- **Slurry Seal**
- **Micro-Surfacing**
- **Cold Mix Overlay**
- **Hot Mix Overlay**



# *Cold Central Plant*

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- ▶ **Cold Central Plant Recycling (CCPR) Is a Viable Alternative When Stockpiles of High Quality RAP are Available or When it is Not Possible to In-Place Recycle the Pavement.**



# CCPR - Process

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- ▶ **Aggregate Feeding/Blending**
- ▶ **Screening/Crushing**
- ▶ **Liquid Metering Systems**
- ▶ **Pugmill Mixing**





# CCPR - Applications

- ▶ Expanded Asphalt (foam) or Emulsified Asphalts are used as Recycling Agent.
- ▶ Different Emulsion Formulations are used for Stockpiling versus Immediate Lay.



# ***Bituminous Recycling Agents***

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## **■ Emulsified Asphalts**

- **Engineered Emulsions**
- **Solvent Free Emulsions (CSS)**
- **High Float Emulsions**
- **With or Without Polymers**

## **■ Expanded Asphalt (Foam)**

## **■ Cement or Lime can be added in small quantities (Recycling Additives) to:**

- **Improve Moisture Resistance**
- **Decrease Curing Time**
- **Increase Initial Strength**



# CCPR - Benefits

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- ▶ **Environmental.** An excellent use of excess asphalt millings saving valuable natural resources.
- ▶ **High Production.** Allows for quick construction time.
- ▶ **Economic.** Depending on the cost of the RAP, cost savings can range from 25% to 75% versus conventional hot or cold mix.
- ▶ **Mix Properties.** Additional aggregates/additives may be added for enhanced mix performance.
- ▶ **Mix Formulations.** With proper additive formulation, the mix may be used in a wide range of applications.

# *Keys to Long Life CIR*

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- ▶ **Project Selection And Site Investigation**
- ▶ **Informed Pavement Design**
- ▶ **Proper Material Selection And Design**
- ▶ **Experienced Contractor And Proper Construction Conditions**

# ***Thickness Design***

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- ▶ **Wearing Surface Must be Designed to Carry Anticipated Traffic**
- ▶ **AASHTO Procedure: CR “a” coef. of 0.30-0.32 (reported range 0.25 to 0.35)**
- ▶ **Pavement ME (MEPDG)**
  - **CIR & FDR Not Getting Full Credit**
  - ***NCHRP 9-51 Characterization of Cold In-Place Recycled and Full Depth Reclamation Materials for Mix and Structural Pavement Design***

# *Recent Survey of 13 Agencies using Partial Depth CIR in USA*

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- **10 of 13 Agencies Reported No Official Traffic Restrictions on CIR Usage**
- **Majority of CIR has been Performed on Low to Moderate Trafficked Pavements**
- **6 of 13 Agencies Reported using CIR on Interstate Pavements**
- **Performance Studies Indicate Traffic had no Adverse Affect on Performance**

# ***No Traffic Restrictions***

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- **Chesner, et al. NYSDOT CIR (TRB 2011)**
  - Higher traffic = longer service life
  - Attributed to better quality of base
- ***NCHRP Synthesis 421 Recycling and Reclamation of Asphalt Pavements Using In-Place Methods***
  - Over utilized on lower volume pavements
  - Under utilized on higher volume pavements



# ***CIR Performance***

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## **▶ Nevada**

- Use FDR & CIR extensively as part of their Pavement Management System**
- Top 5 States Pavement Smoothness**

## **▶ Kansas**

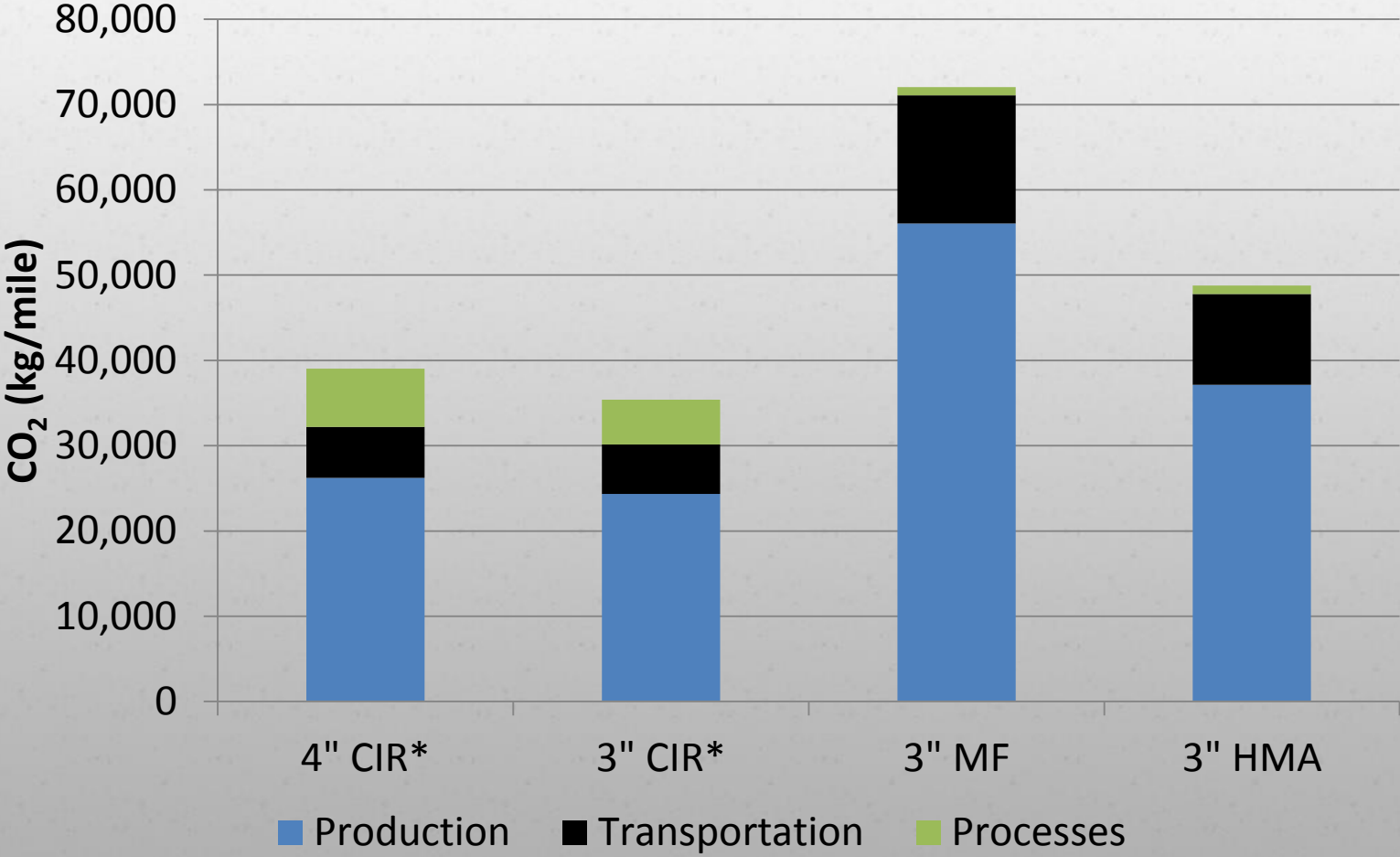
- Performing CIR Over 30 years**
- Top 5 States in Pavement Smoothness**

## **▶ New York – CIR Over 300 projects**

## **▶ Vermont**

- CIR longer service life than Mill & Fill**

# Sustainability NYSDOT (C-06-21)



**\* CIR includes 1.5" HMA**

# *CIR Sustainability*

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- ▶ **Alkins, Lane & Kazmierowski, *TRR 2084***
- ▶ **Comparison of CIR to equal thickness of Mill & Fill resulted in:**
  - **62% less reduction in aggregate resources**
  - **52% reduction CO<sub>2</sub> emissions**
  - **54% reduction NO<sub>x</sub> emissions**
  - **61% reduction SO<sub>2</sub> emissions**

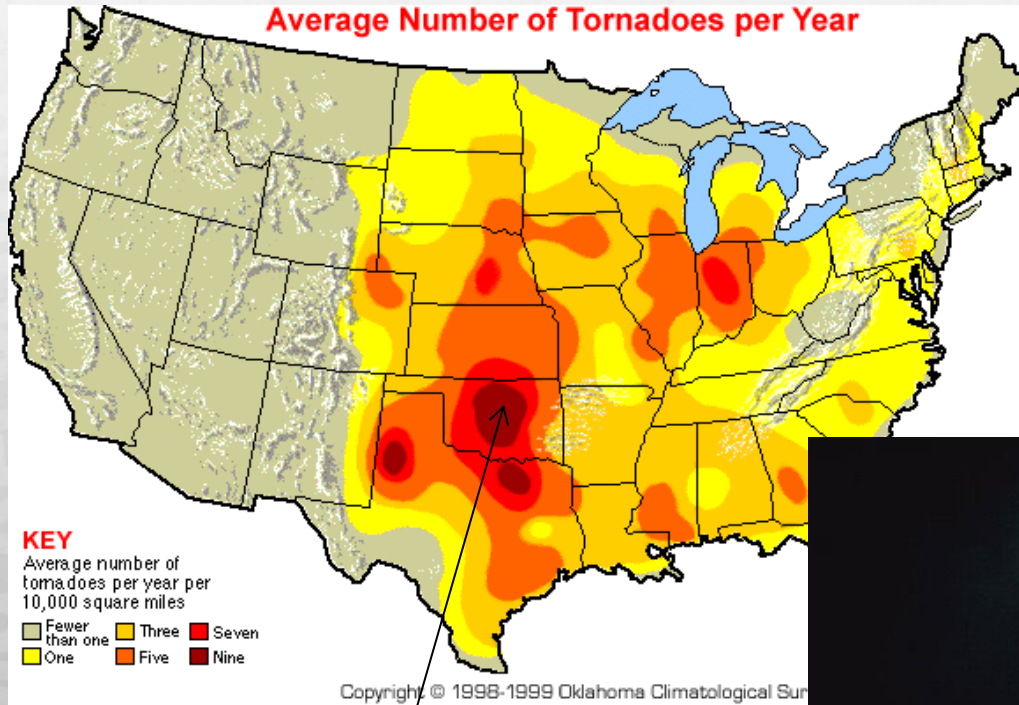
# ***CR Advantages***

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- ▶ **Cost Effective**
- ▶ **Conserves Energy**
- ▶ **Conserves Materials**
- ▶ **Improves Mix Characteristics**
- ▶ **Improves serviceability and increases structural capacity**
- ▶ **Reduces Construction Time**
- ▶ **May Be Performed Under Traffic**



# Thank You



**Heart of  
Tornado Alley**

**Stillwater, OK  
My Home**

