The Evolution of Hot In-Place Recycling

presented to

The Ministry of Transportation Ontario

by

JP Road-Tech Ltd

February 23, 2024

Attending today from JP Road-Tech Ltd

- Mr. Zhishan Wang – President
- Mr. Jianjun Wang – Managing Director
- Patrick Wiley - Vice-President

Today's Discussion

1. JP Road-Tech Ltd Introduction
2. The Need for Sustainable Paving Solutions
3. The JP6000 Recycling System
4. HIR Projects in China
5. Ontario HIR Discussion

1. JP Road-Tech Ltd Introduction

- New Canadian Company Headquartered in Toronto, Ontario
- Ontario based HIR Systems Design, Manufacturing and Contracting Operations.
- Granted the N.A. Exclusive Rights to the JP6000 Asphalt Recycling System
- Committed to the Continuous Improvement of Green Asphalt Technology

Experienced Team

- Over 10 million m2 of HIR Project Experience Past 10 Years
- 4.5 million m2 in Canada (including 900,000 m2 MTO)
- 6 million m2 in China.

Five Key Competencies

1. Market Research	▪ Understand Customer Needs ▪ Understand Technology Trends
2. Product Development	▪ Develop Customer Based Solutions ▪ Design , Prototype and Testing
3. Manufacturing	▪ Quality Management ▪ Technical Support
4. Demand Creation	▪ Presentations to MTO ☺ ▪ Successful HIR Projects
5. Project Management	▪ Quality & Safety Management ▪ Customer Satisfaction

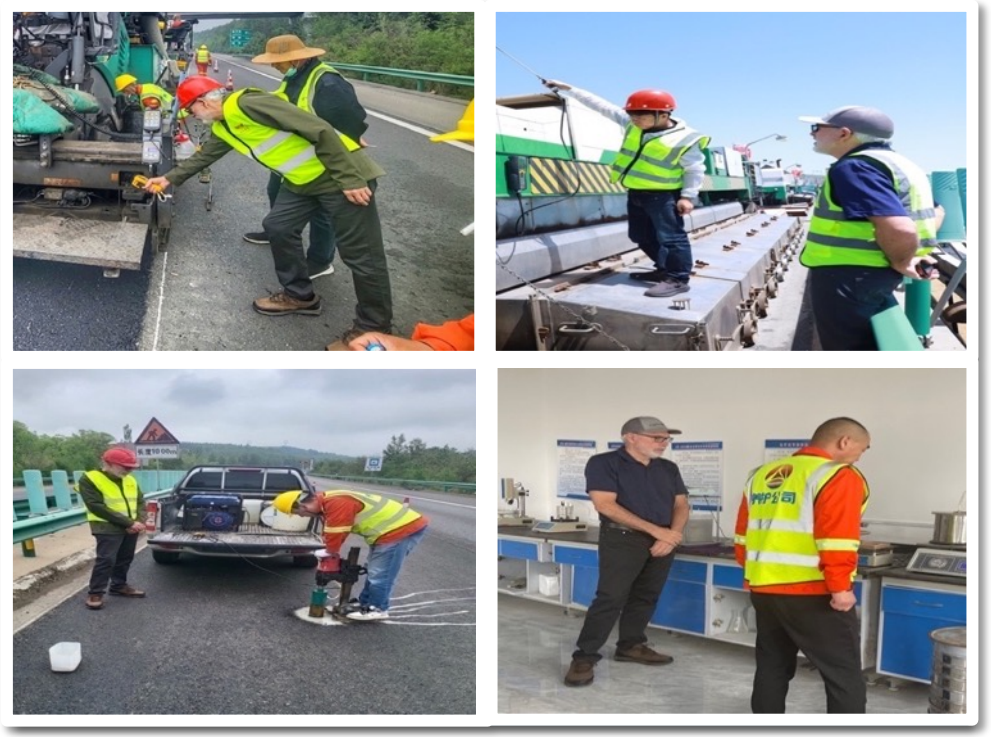
Five Key Innovations

1. Recirculating Hot Air Heaters	▪ Reduced GHG – Opacity <10% ▪ Safe Working Environment
2. Hot Milling System	▪ Consistent 50mm Depth ▪ Prevents Aggregate Fracture
3. Windrow Heater	▪ Increases Windrow Temp to 140C ▪ Creates Uniform Mix Temperatures
4. Batch Pugmill Mixer System	▪ Weighed Batch Metering System ▪ 30 Second Pugmill Mixing Time
5. Mixer-Paver Machine	▪ Hot Bond at Joint & Underlying Surface ▪ Smooth, Segregation Free Surface

Customer Satisfaction

HIR Observations from China

This presentation includes observations and images from five HIR projects I visited during a four-month trip to China in 2023



The China Trip was Hosted by

- The Jiapeng Group, China
- Designs, Manufactures and Operates JP6000 Systems in China
- Provides Long Term Technical Support to JP Road-Tech Ltd
- Performs Conventional Road & Bridge Design/Construction

The Jiapeng Team





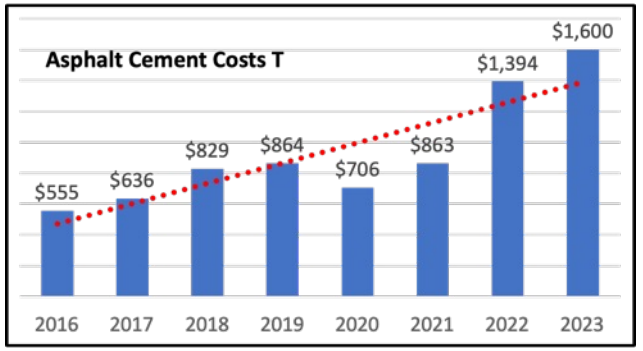

2. The Need for Sustainable Technologies

Sustainability: Meeting the needs of the present without compromising the ability of future generations to meet their own needs. (United Nations)

The Road to Zero

Reduce Emissions

Conserve Materials

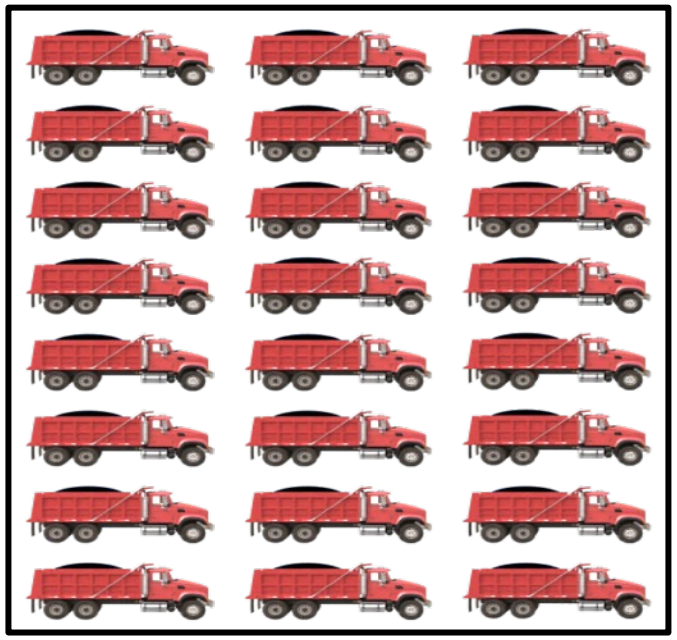


Manage Life Cycle Cost

HIR = 75% Reduction in New Paving Materials

HIR =
6 Loads Per Lane Km

Mill & Fill =
24 Loads Per Lane Km



HIR = 90% Reduction in Trucking

Mill & Fill
60 Loads Per Lane km

30 Loads → Plant

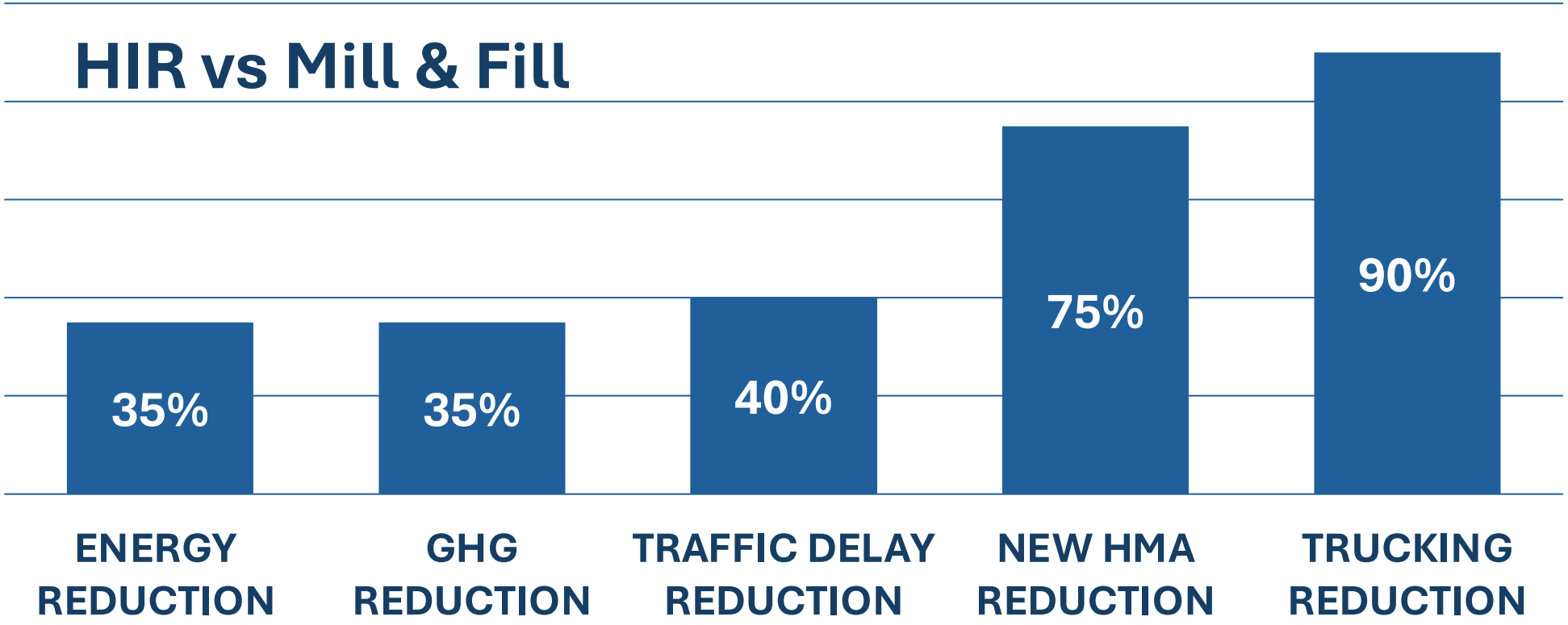
30 Loads → Paver

HIR
6 Loads Per Lane km

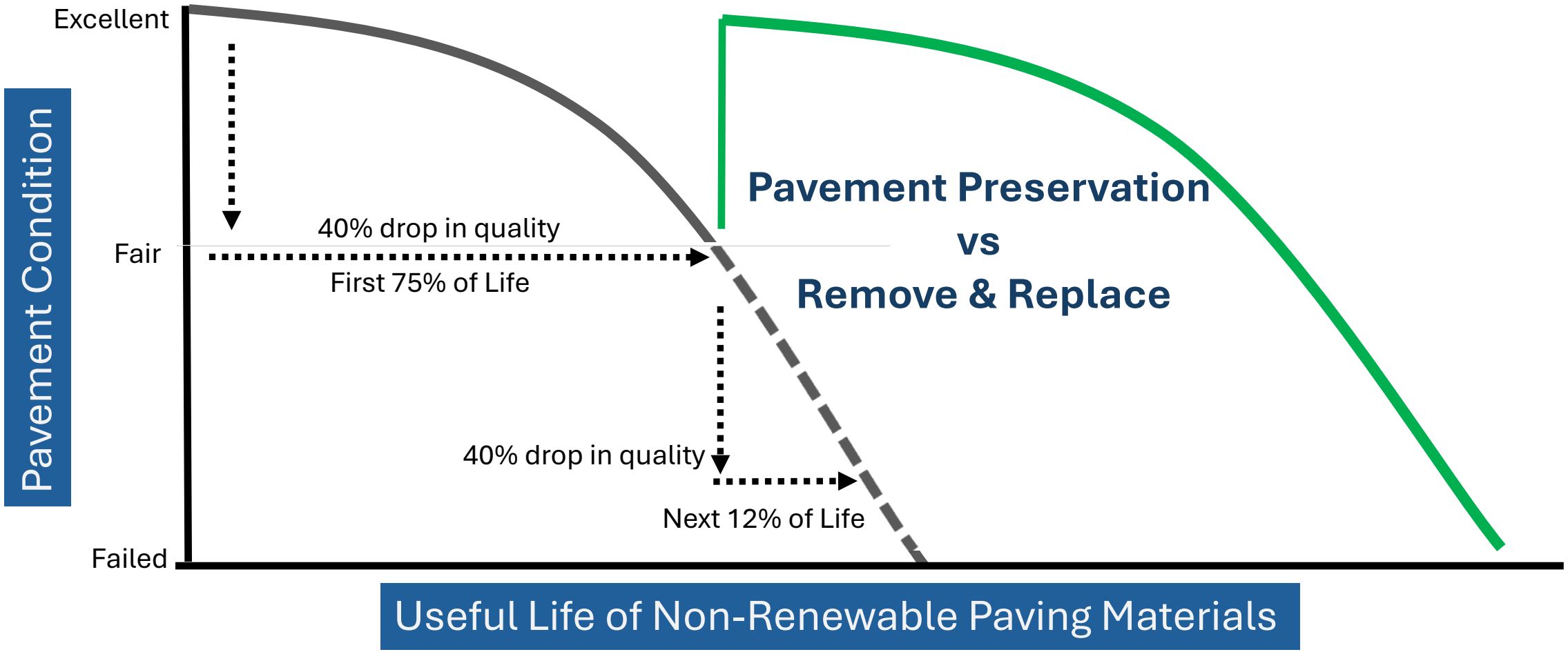
0 Loads → Plant

6 Loads → HIR

HIR = A More Sustainable Solution



HIR = Doubles the Useful Life of Paving Materials



HIR = GreenPave Gold

HIR GreenPave Score		
✓	Long Life Pavements	3
✓	Recycled Content	5
✓	Local Materials	2
✓	Reduced Energy	3
✓	Reduced GHG Emissions	3
✓	Total Score. (≥15 = Gold)	16

Climate change & sustainability awareness

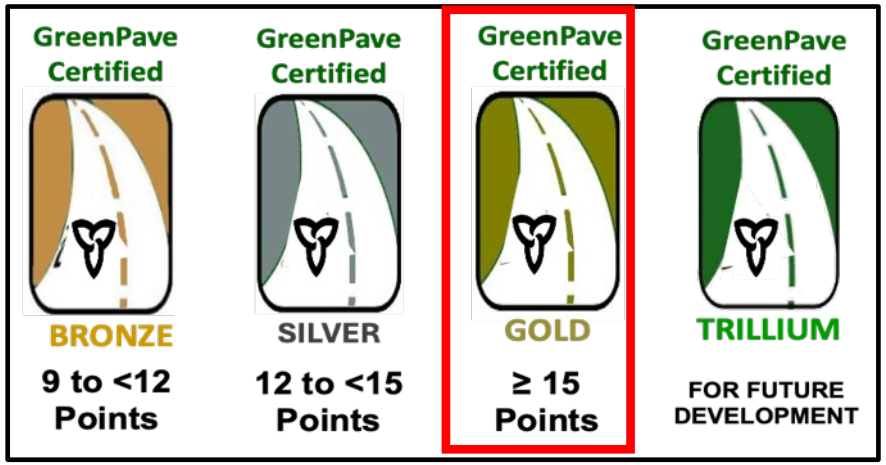
Inspired by GreenRoad (WSDOT)

Reviewed GreenLITE (NYSDOT)

Customized for Ontario (since 2008)

MTO GreenPave

Focus specifically on the pavement component only



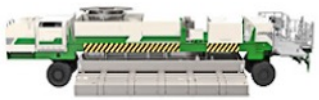
3. The JP6000 Recycling System

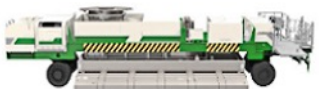
Baomao Expressway, Shanxi Province
May 2023

Five Key Features

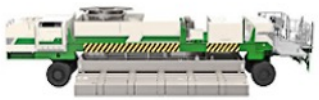
1. Recirculating Hot Air Heaters	▪ Reduced GHG – Opacity <10% ▪ Safe Working Environment
2. Hot Milling System	▪ Consistent 50mm Depth ▪ Prevents Aggregate Fracture
3. Windrow Heater	▪ Increases Windrow Temp to 140C ▪ Creates Uniform Mix Temperatures
4. Batch Pugmill Mixer System	▪ Weighed Batch Metering System ▪ 30 Second Pugmill Mixing Time
5. Mixer-Paver Machine	▪ Hot Bond at Joint & Underlying Surface ▪ Smooth, Segregation Free Surface

JP6000 Equipment





Preheaters x 3

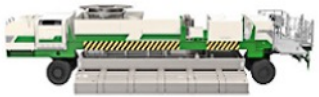
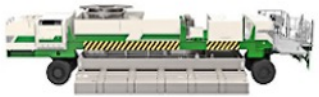
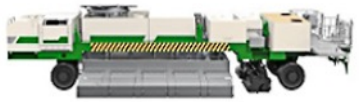


Heater Miller

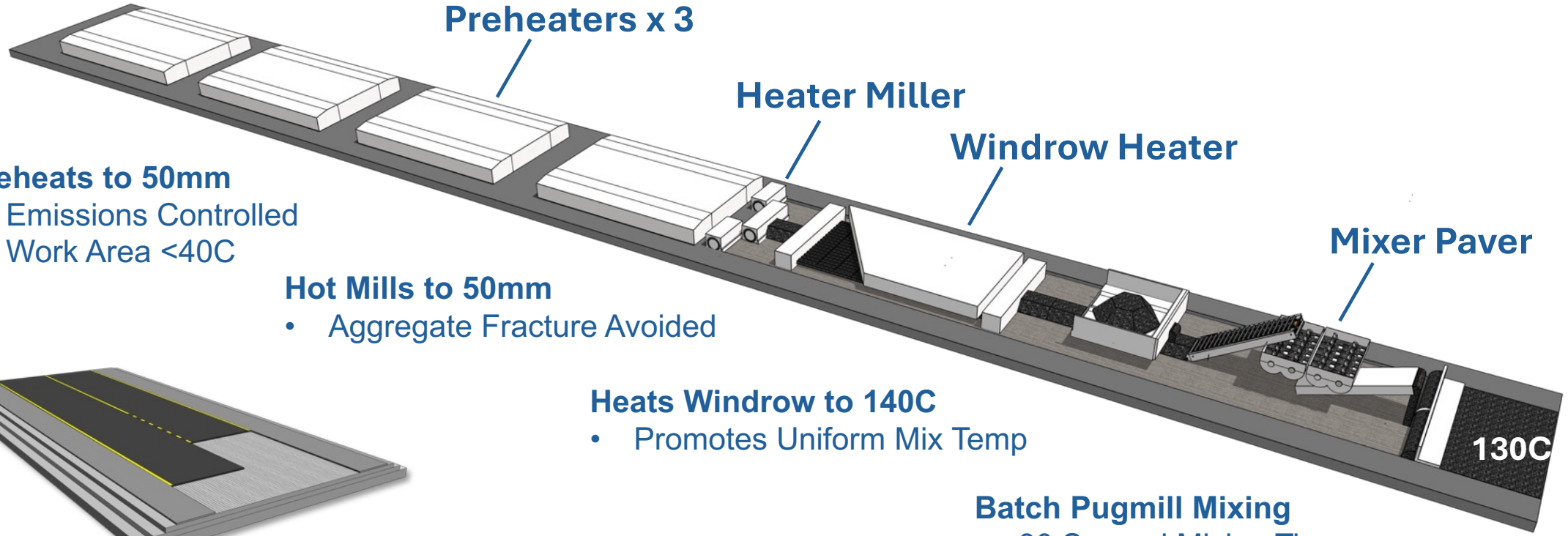
Windrow Heater

Mixer Paver

JP6000 Process

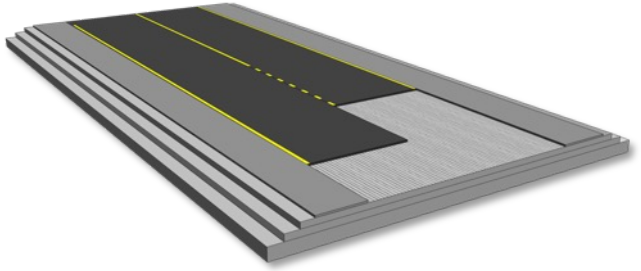





Preheaters x 3 | Heater Miller | Windrow Heater | Mixer Paver



Preheats to 50mm
- Emissions Controlled
- Work Area <40C

Hot Mills to 50mm
- Aggregate Fracture Avoided



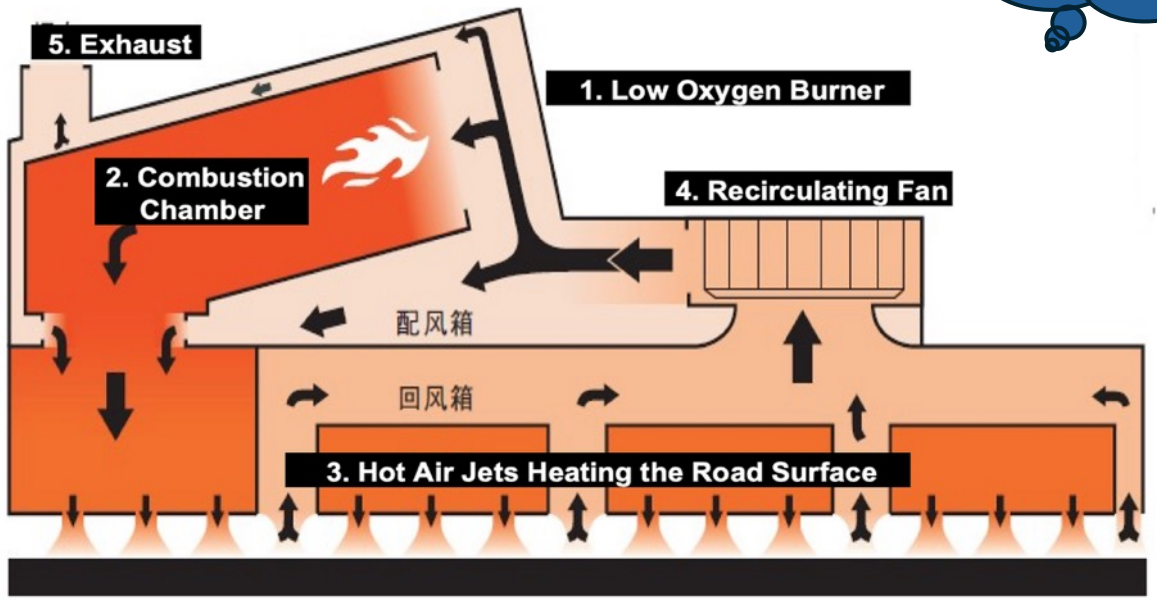
Heats Windrow to 140C
- Promotes Uniform Mix Temp

Batch Pugmill Mixing
- 30 Second Mixing Time

Recirculating Hot Air Heating Systems

Low Emission

Energy Efficient



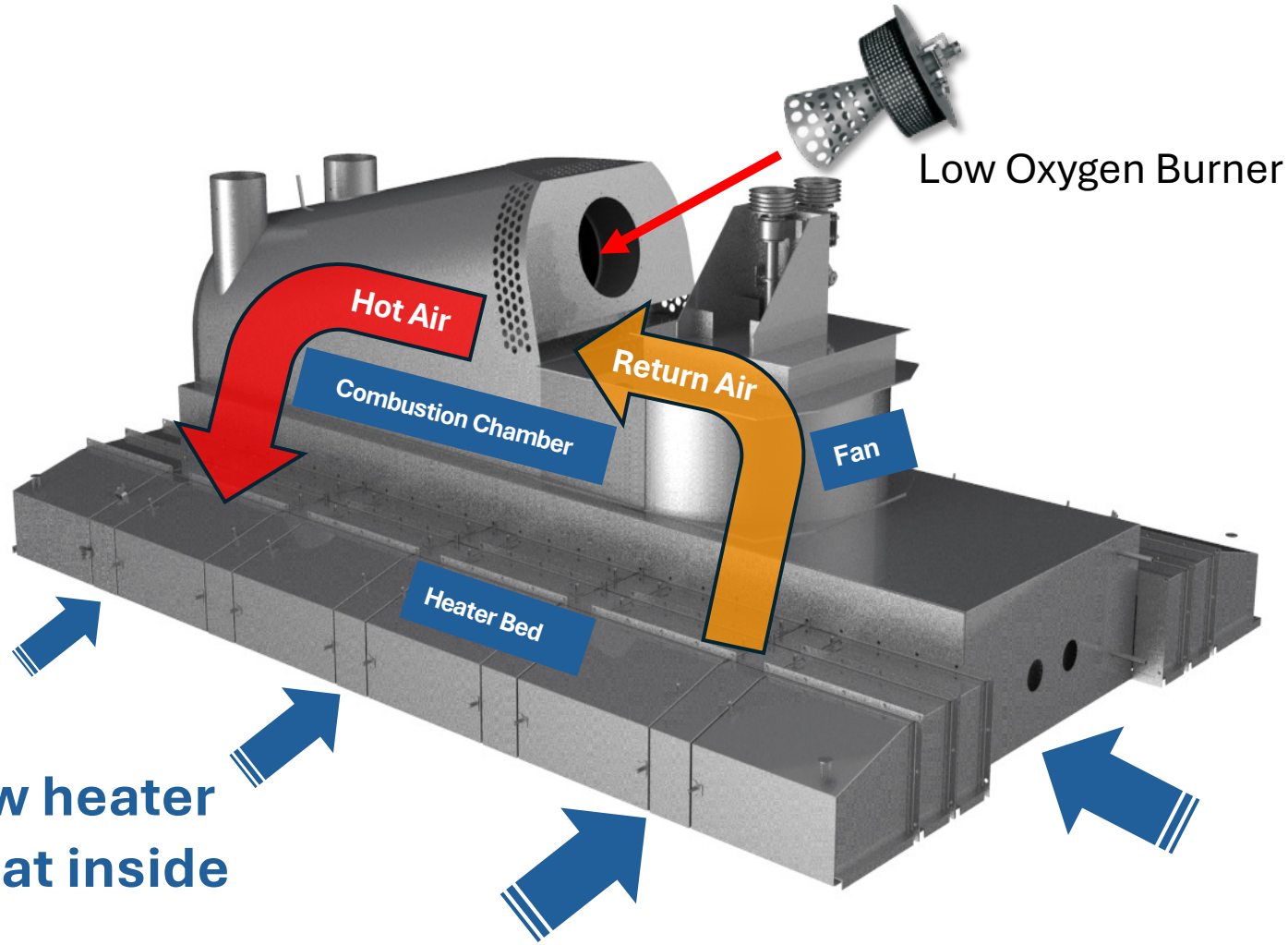
1. **Low Oxygen Burner**
2. **Combustion Chamber**
3. **Hot Air Jets the Heat Surface**
4. **Recirculating Fan.**

Air is heated by the **(1.)**Low Oxygen Burner in the **(2.)** Combustion Chamber and is then forced through **(3.)** Hot Air Jets to heat the road surface. **(4.)** The Recirculating Fan returns it to the combustion where reheated for reuse and emissions are incinerated.

Digital Temperature Controls

Digital controls are widely used to ensure the designed temperature targets are achieved at each major operation of processing.

Fumes and Heat are Captured & Contained



Negative pressure below heater contains the fumes & heat inside

Prevents Blue Smoke & Binder Damage

Common HIR Problem

- Blue Smoke Emissions
- Binder Damage

JP6000 Solution

- Effective Emissions Control
- Effective Temperature Control

Enhanced Worker Safety

Common HIR Problem

- Workers Exposed to Hazardous Fumes
- Work Area Temperature >50C

JP6000 Solution

- Negative Pressure contains Fumes.
- Work Area Temperature <40.

Enhanced Motorist Safety

Common HIR Problem

- Reduced Motorist Visibility
- Workers are Endangered

JP6000 Solution

- Emissions are Controlled
- Cars Pass Safely

Hot Milling

- Prevents Aggregate Fracture
- Gradation is Maintained

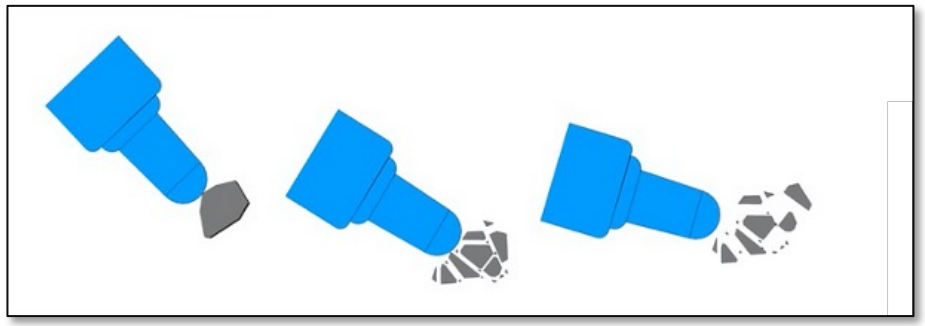
The Hot Milling Advantage

Cold Milling Problems

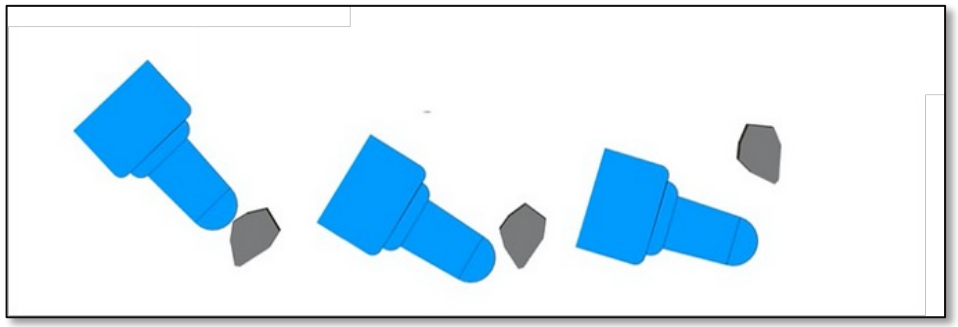
- Aggregates Fractured
- Gradation Altered / High Fines
- Average RAP Content +- 20%

Hot Milling Solution

- Surface Heated / Softened
- Prevents Aggregate Fracture
- Average Hot RAP Content +- 80%



Cold Milling



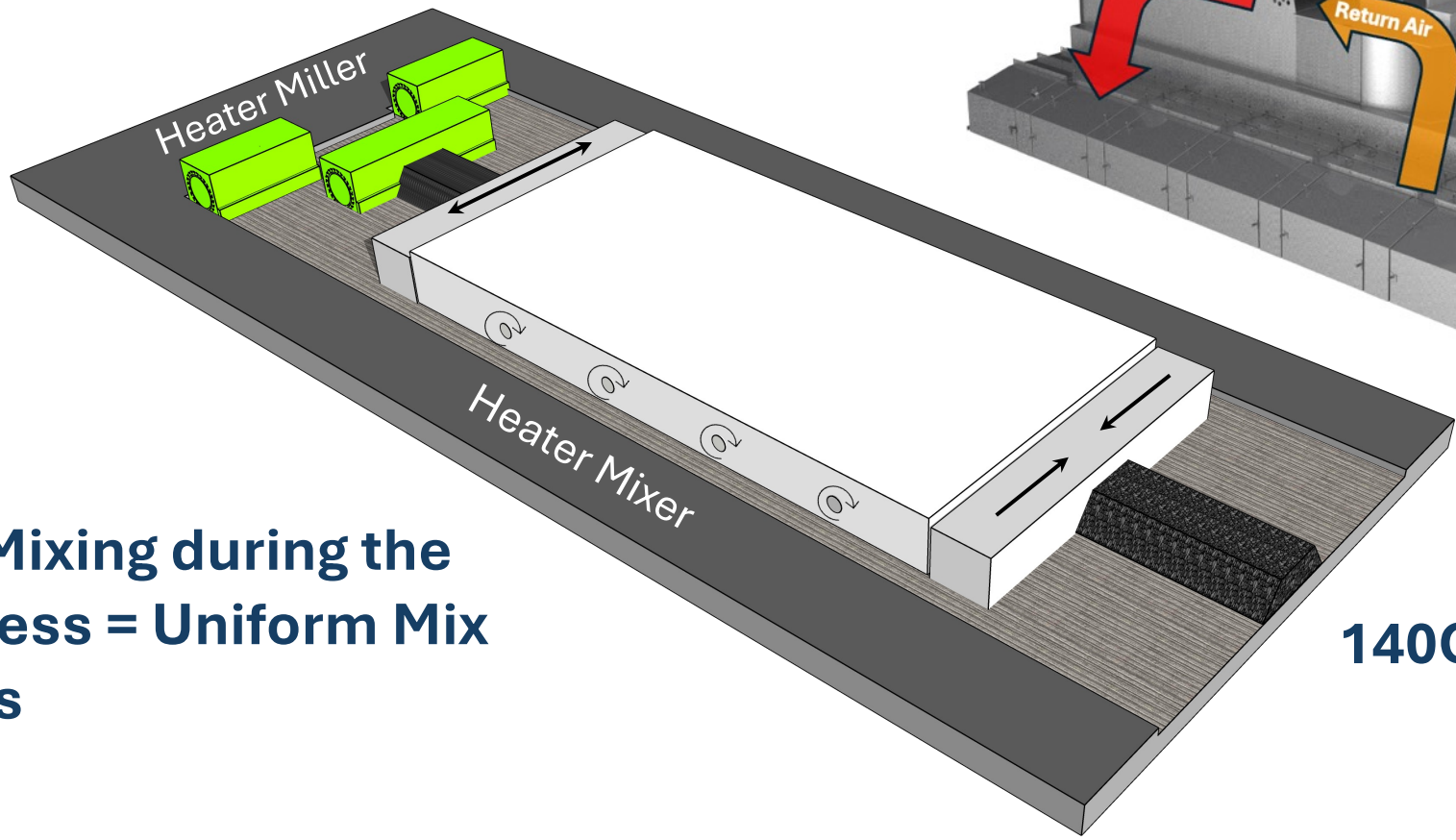
Hot Milling

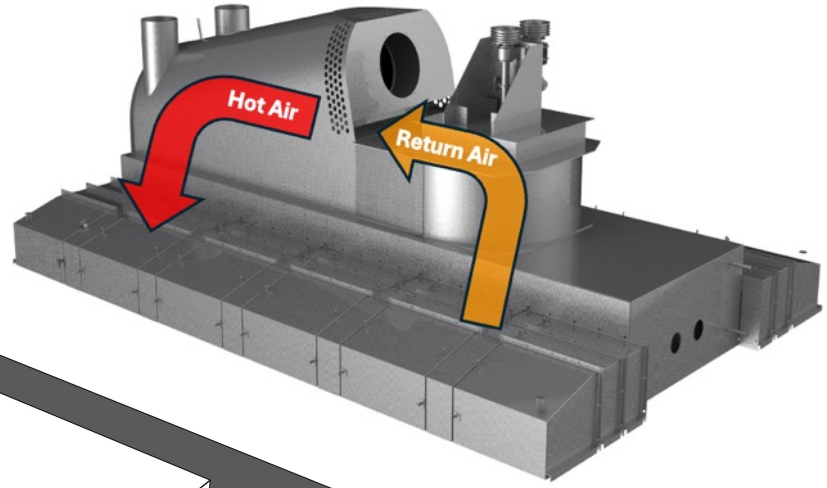
The Windrow Heater

- Heats Windrow to 140C
- Low Oxygen Environment
- Creates Uniform Mix Temperatures

The Windrow Heater

The Windrow is Heated to >140C in a Low Oxygen Environment





Continuous Mixing during the Heating Process = Uniform Mix Temperatures

140C Windrow

The Windrow Heater

- Increases Windrow Temp to 140C
- Heats/Mixes in Low Oxygen Environment
- Creates Uniform Mix Temperatures

- Improves Rejuvenator Effectiveness
- Improves Mix Laydown & Workability
- Improves Compaction

The Mixer Paver

Combines the Mixer and Paver Functions into One Machine

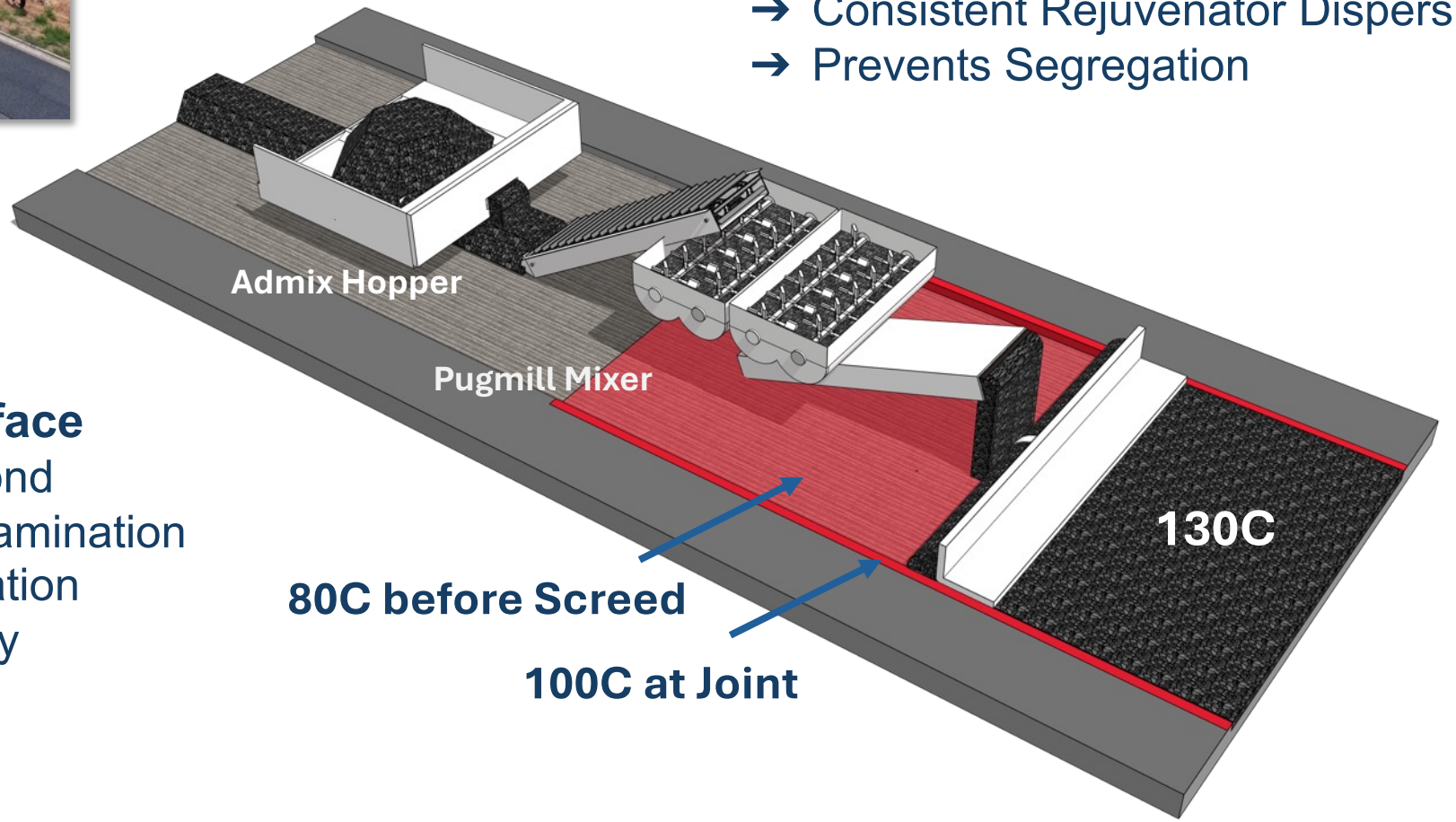
Reduces Mix Temperature Loss Between Mixing and Paver Processes

Qingyin Expressway

The Mixer Paver

Weighed Batch Mixing System

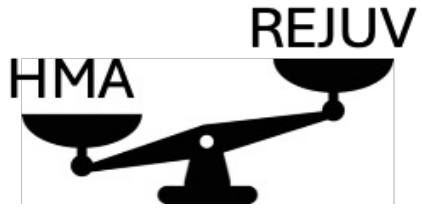
- ➔ 30 Second Mixing Time
- ➔ Accurate Rejuvenator Metering
- ➔ Consistent Rejuvenator Dispersion
- ➔ Prevents Segregation

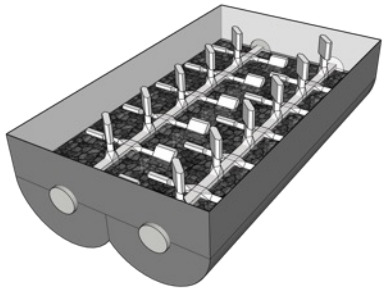


Preheated Paving Surface

- ➔ Creates a Thermal Bond
- ➔ Prevents Surface Delamination
- ➔ Prevents Joint Separation
- ➔ Improves Compatibility

Batch Mixer = Precise Metering & Homogenous Mixing

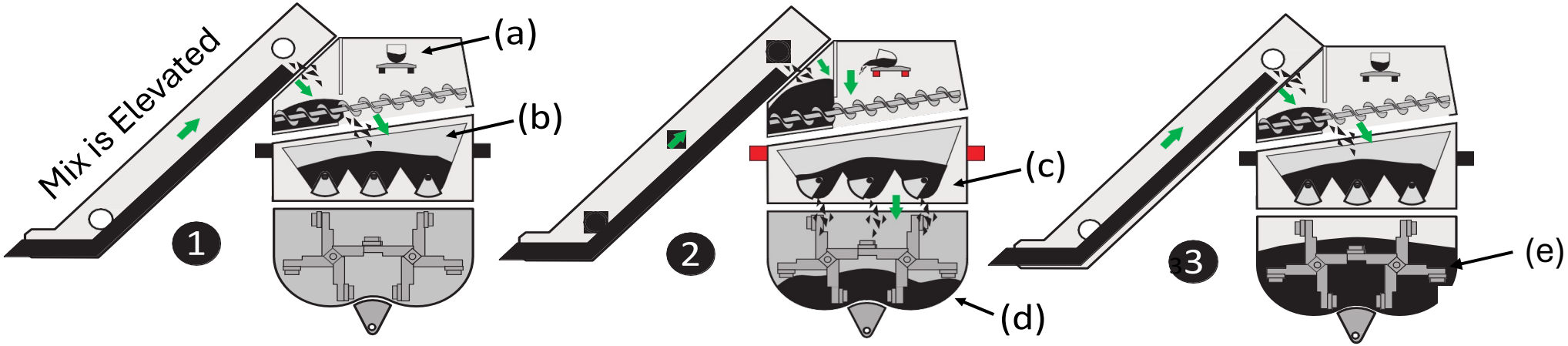




1. The Rejuvenator & HMA are weighed separately.

2. The Weighed Batch is released to Pugmill

3. 30 second Mixing Time in Twin-Shaft Pugmill



Smooth and Consistent

High Quality Recycled Pavement

- Consistent Surface
- 130C Behind Paver
- Hot Joints

- Recycling Widths 3.5 to 4.5 Meter
- Consistent Compaction
- Smooth Ride

Looks and Performs Like a Newly Paved Surface

4. HIR Projects in China

Typical Projects

- 4 Lane Expressways
- 100,000 to 300,000 m2
- Polymer Modified Binders
- Some Projects SMA
- 50 mm depth
- 20% Admix
- 0.3% to 0.6% Rejuvenator

Shaanxi Province - 225,000 m2

Xinjiang Province – 260,000 m2

Henan Province – 175,000 m2

Consistent Test Results

Test		Measured Data	Design Data	Result
Asphalt Content	Asphalt using (%)	4.52	4.43	pass
Marshall	stability (kN)	16.14	≥8	pass
	flow value(mm)	2.2	2.0-4.0	pass
	Air void (%)	4.6	4 - 6	pass
Onsite Tests	compaction%	94.3	93%	pass
	friction coefficient	82	>55mm	pass
	thickness (mm)	55mm	50mm	pass

Test Method	Unit of Measure	Specification	Before HIR	0.3% Rejuvenator	0.4% Rejuvenator	0.5% Rejuvenator
Penetration 100g, 5s, 25℃	0.1mm	40-60	24	47	60	68
Ductility 5cm/min, 15℃	cm	Measured	5.7	19.1	24	28.2
Softening Point	℃	≥47	63.0	55.5	52.5	49.5

Jiapeng R&D & Manufacturing Center, Dalian City

What we are working on

- Improvements to Quality, Efficiency Production & Environmental Impact
- Next Generation Rejuvenators
- On-Site Aggregate Heating System
- Intelligent Control Systems

Jiapeng Asphalt Rejuvenator

- Restores the original properties of the asphalt binder
- Joint study with the University of Waterloo, Canada
- Developed by the Jiapeng Group

UNIVERSITY OF WATERLOO
FACULTY OF ENGINEERING
Department of Civil &
Environmental Engineering

Conclusion: HIR is a More Sustainable Solution

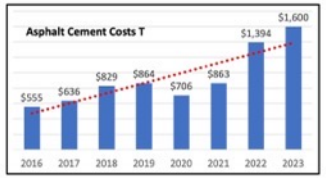
The Need

Sustainability: Meeting the needs of the present without compromising the ability of future generations to meet their own needs. (United Nations)

The Road to Zero

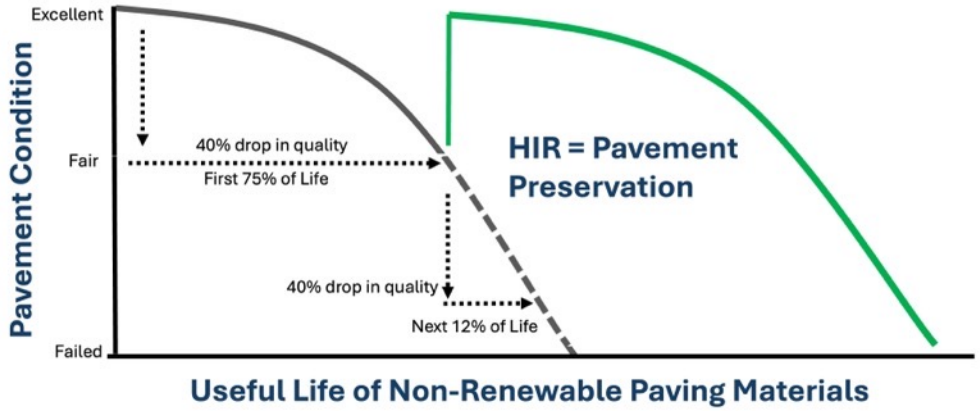
Reduce Emissions

Conserve Materials

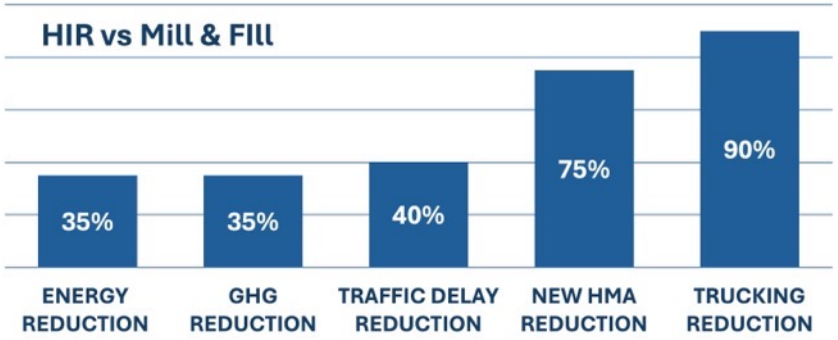


Manage Life Cycle Cost

HIR = Pavement Preservation

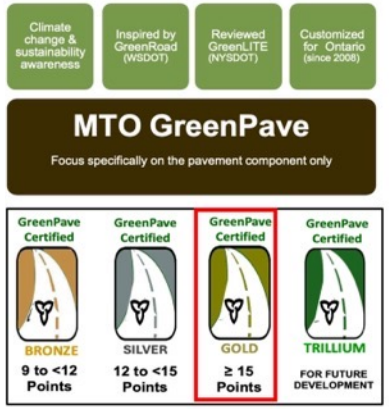


HIR = Reuse and Reduce



HIR = GreenPave Gold

HIR is GreenPave Gold Rated		
✓	Long Life Pavements	3
✓	Recycled Content	5
✓	Local Materials	2
✓	Reduced Energy	3
✓	Reduced GHG Emissions	3
✓	Total Score. (≥15 = Gold)	16



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Customer Satisfaction

Thank You!

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