Emerging Technologies
Asphalt Shingle Recycling

Massachusetts Joint
C&D Subcommittee and RMD Workgroup Meeting
December 11, 2025

Dan Horton
Asphalt Shingle Recycling Systems

- Evolution of Processing Technology
- Leading States Use of RAS 2023
- What is Holding us Back?
- Balanced Mix Design Analysis
- Roofing Manufacturing Initiative 50% Diversion by 2035
- Life Cycle Analysis Cooperation
- Upcoming Events

Growth of End Markets through Processing Innovation

From <3/8” RAS to…..

ASPHALT LIMESTONE POWDERS

Different grades according to max/min and distribution of size.

AGGREGATES

<8 mesh angular sand.

ASPHALT LIQUID

Different methods to perfect extraction.

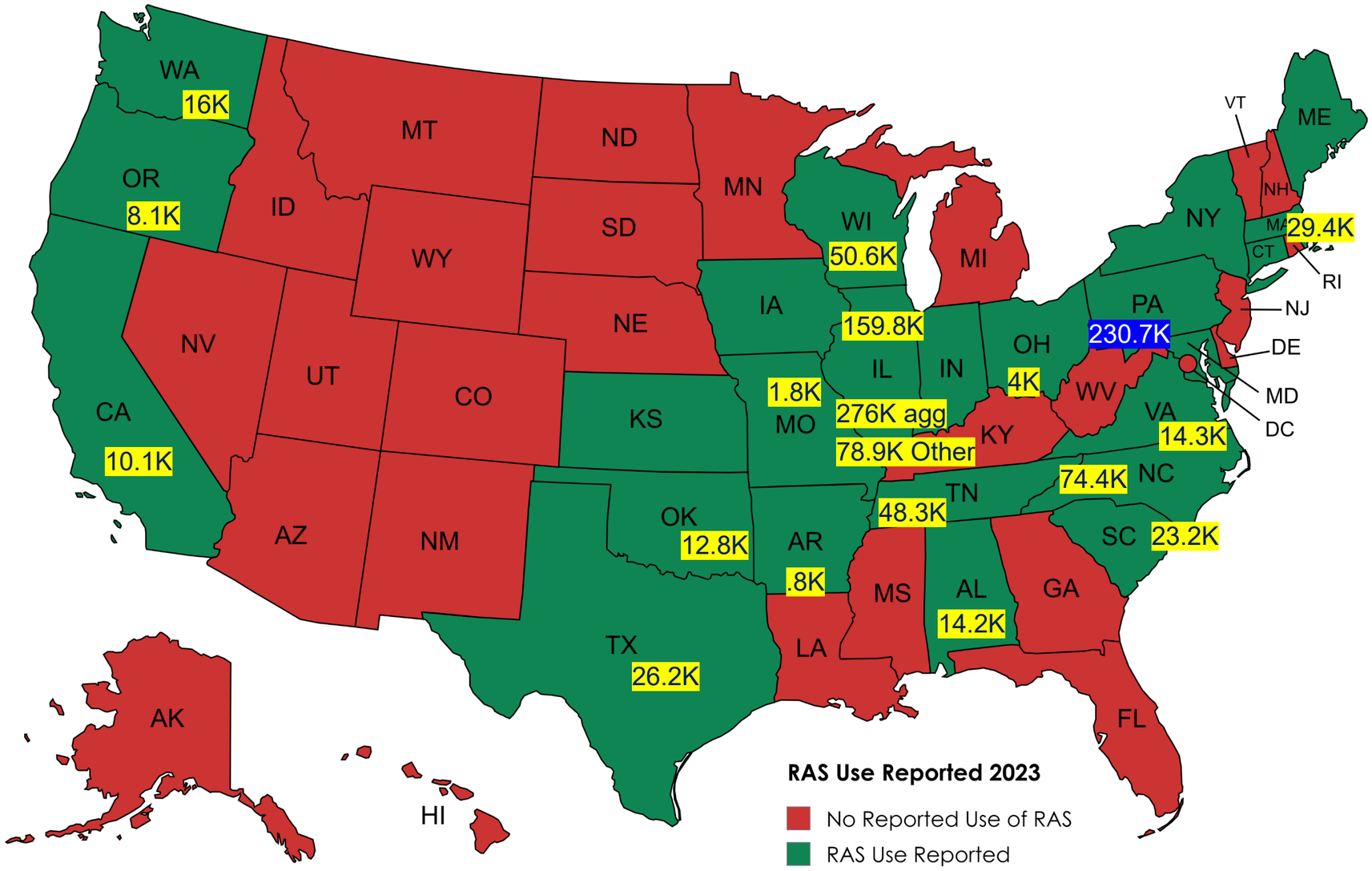
An Industry Committed to Increase Recycled Rates Through Technology

CDRA Construction & Demolition Recycling Association

ASPHALT ROOFING MANUFACTURERS ASSOCIATION

NAPA NATIONAL ASPHALT PAVEMENT ASSOCIATION

<3/8” RAS Use in Roads



92% of RAS utilization in the USA came from 7 states.

24 States reported use in 2023.

797,000 Tons used in HMA

200,00 Tons Used as Aggregate

61,000 Tons Other

SOURCE: NAPA Asphalt Pavement Industry Survey Recycled Materials and Warm Mix, 2023, Analysis by Dan Horton

What is Holding Us Back

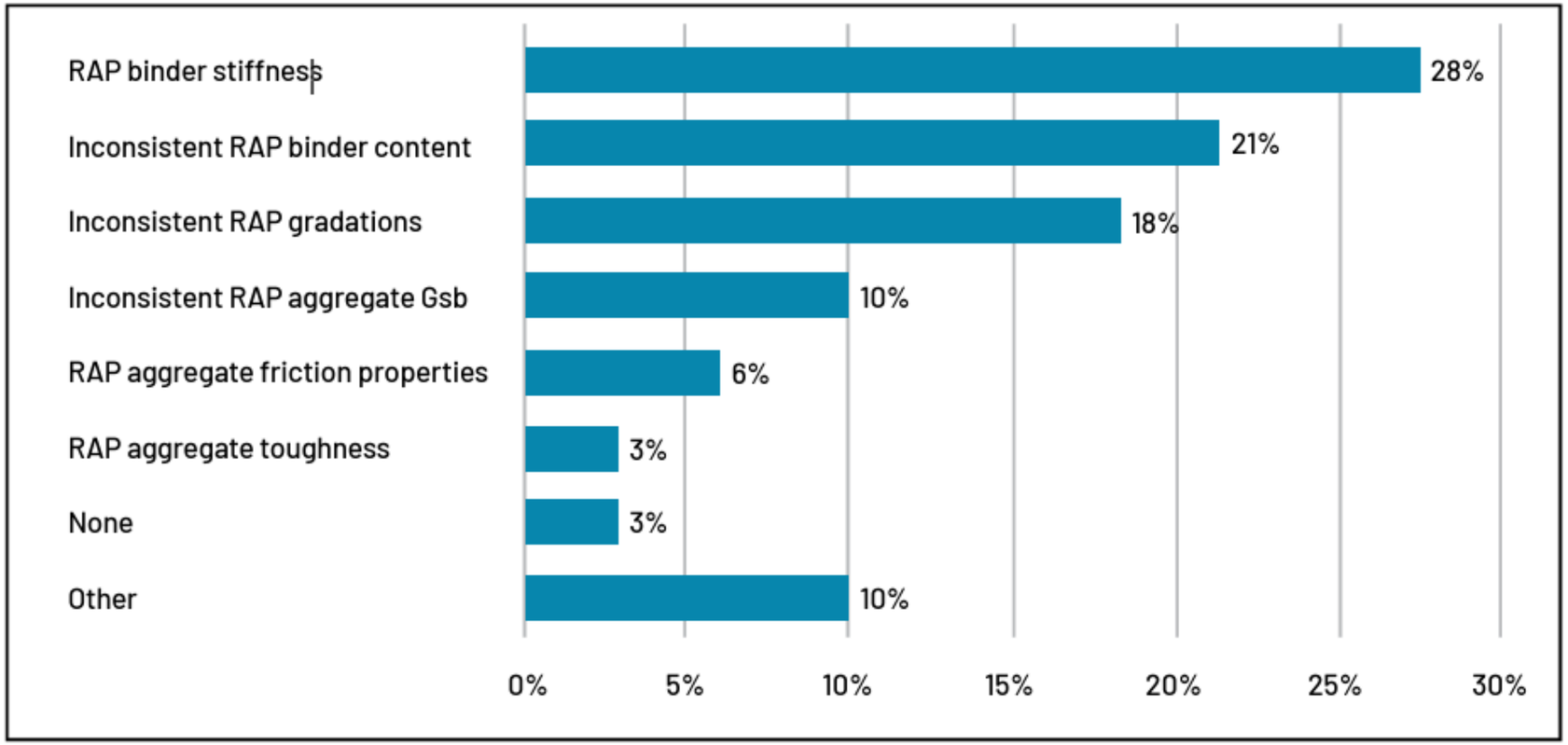


Figure 5 **RAP-related limiting factor according to State Agencies**

Recycled asphalt materials, including RAS and RAP, face the same limiting factors.

Source: Barriers to Higher RAP Usage, NAPA SR-229
Source: **Comparison of RAP and RAS, Making RAS Work through Balanced Mix Design,** Nam H. Tran, PhD, PE, Associate Director and Research Professor
Third ARMA Virtual Asphalt Roofing Recycling Forum
November 18, 2025

Performance Issues

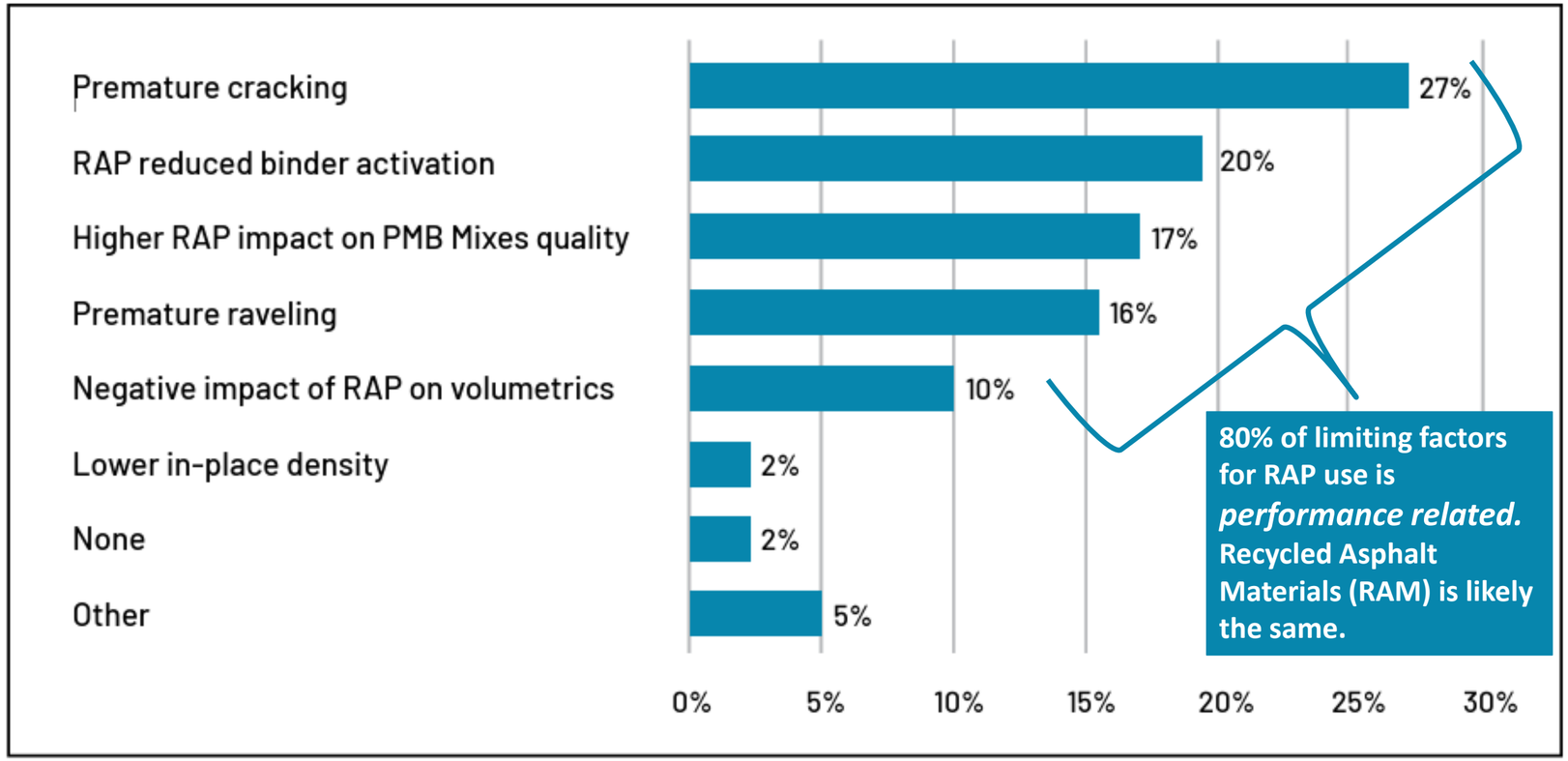


Figure 6 Performance concerns limiting RAP use according to State Agencies

Source: Barriers to Higher RAP Usage, NAPA SR-229
Source: **Comparison of RAP and RAS, Making RAS Work through Balanced Mix Design,** Nam H. Tran, PhD, PE, Associate Director and Research Professor
Third ARMA Virtual Asphalt Roofing Recycling Forum
November 18R
Source: Recycled Asphalt Binder Study, Wisconsin DOT

In 2021, the term **recycled asphalt materials RAM (RAP and RAS)** was introduced in a study by the Wisconsin DOT and NCAT.

The study examined the interaction of their different components

Recycled asphalt materials blends include:

- Virgin binders with and without polymer modification
- Aged binder from RAM
- Recycling agents (RAs).

Balanced Mix Design

In September 2015, the former Federal Highway Administration (FHWA) Expert Task Group (ETG) on Mixtures and Construction formed a Balanced Mix Design Task Force, which consisted of asphalt researchers, practitioners, and pavement engineers from federal and state highway agencies, asphalt contractors, consultants, and academic and 02 research institutions.

The task force defined balanced mix design (BMD) as “asphalt mix design using performance tests on appropriately conditioned specimens that address multiple modes of distress taking into consideration mix aging, traffic, climate, and location within the pavement structure.

SOURCE: https://www.asphaltpavement.org/expertise/engineering/resources/bmd-resource-guide

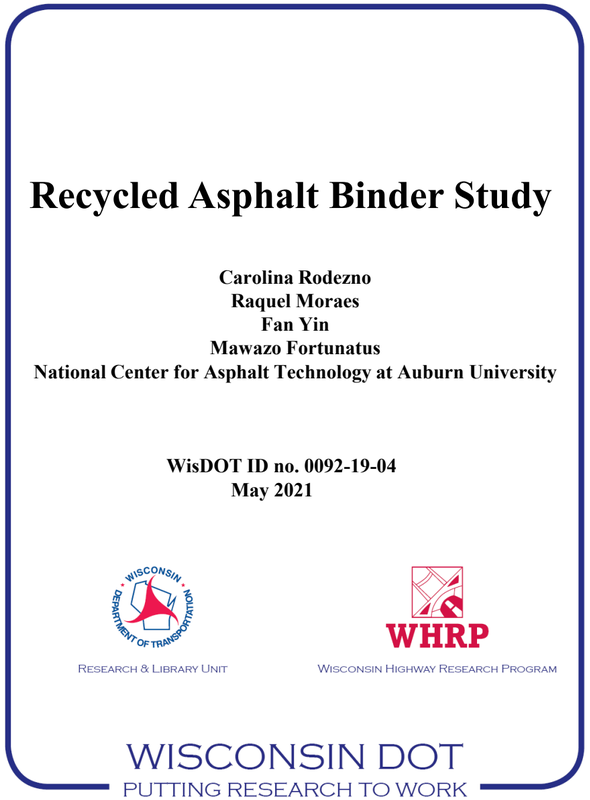
Balanced Mix Design Compared to RAS Use in HMA

STATE RANKING BY TONS OF HMA/WMA		HMA/WMA Market Size in mm tons 2023	RAS Use		Applicable Mixture Type	BMD Approach	Performance Testing for Production Acceptance	Softer Binder or Recycling Agent NOTE *Representative of only the respondents to survey and do not completely reflect practices in a given state	
			2022	2023				Softer binder	Recycling Agent
4	Illinois	15,200,000	55,300	159,800	High ESAL Mixtures	Approach A - Volumetric design with performance specification	Yes, I-FIT & HWTT for "Pass/Fail"	33%	6%
4	Illinois			276,300		Aggregate			
4	Illinois			78,900		Other			
3	Pennsylvania	21,500,000	125,700	230,700	Wearing and binder course mixtures	Pre-implementation	N/A	0%	0%
7	North Carolina	12,300,000	40,500	74,400	Superpave surface mixtures	Pre-implementation	No	100%	0%
9	Wisconsin	10,300,000	53,800	50,600	Primary Mainline Upper Layer	Approach A - Volumetric design with performance specification	No, Production Testing for Informational Purposes Only	39%	3%
10	Tennessee	9,900,000	29,200	48,300	All Mixtures	Pre-implementation	To be determined	3%	0%
16	Massachusetts	6,400,000	3,400	29,400	Superpave Mixtures	Pre-implementation	No	0%	0%
1	Texas	48,500,000	105,800	26,200	Surface mixtures	Approach A - Volumetric design with performance specification	Yes, "Pass/Fail"	0%	0%
14	South Carolina	7,900,000	7,500	23,200	SMA and specific Surface and Intermediate mixes	Pre-implementation	No, but field verification	0%	0%
18	Washington	6,000,000	46,800	16,000	Superpave Mixtures	Pre-implementation	Yes, Test Section	50%	0%
	Virginia	12,500,000	0	14,300	Surface Mixtures	Approach B - Volumetric Design with Performance Optimization	Yes, "Pass/Fail"	0%	0%
15	Alabama	7,000,000	0	14,200	Superpave Mixtures	Approach C - Performance-Modified Volumetric Design	Yes, "Pass/Fail"	0%	0%
21	Oklahoma	5,100,000	6,900	12,800	Superpave Mixtures	Approach B - Volumetric Design with Performance Optimization	No	100%	25%
2	California	26,600,000	100	10,100	Long-life pavement mixtures, Cracking Test Performance Testing for Production Acceptance high RAP/RAS mixtures	Approach C - Performance-Modified Volumetric Design	Yes, HWTT for "Pass/Fail"	50%	25%
8	Indiana	14,000,000	2,100	4,600		n/a		30%	0%
11	Minnesota	9,300,000	12,500	0		n/a		0%	0%

SOURCE: https://www.asphaltpavement.org/expertise/engineering/resources/bmd-resource-guide/implementation-efforts

Analysis by Dan Horton

Balanced Mix Design Studies



Recycled Asphalt Binder Study

Carolina Rodezno
Raquel Moraes
Fan Yin
Mawazo Fortunatus
National Center for Asphalt Technology at Auburn University

WisDOT ID no. 0092-19-04
May 2021

RESEARCH & LIBRARY UNIT

WISCONSIN HIGHWAY RESEARCH PROGRAM

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NCHRP 09-71 [Active]

Framework for Design, Production, and Placement of Balanced Asphalt Mixtures

Project Data	
Funds:	$649,942
Staff Responsibility:	Sadaf Khosravifar
Research Agency:	University of Massachusetts
Principal Investigator:	Walaa S. Mogawer
Effective Date:	4/28/2025
Completion Date:	6/30/2028
Comments:	Research In Progress

BACKGROUND

Balanced mix design (BMD) of asphalt mixtures is an approach that addresses different modes of distress through mechanical tests on conditioned specimens that consider mix aging, traffic, climate, and location within the pavement structure. These tests are intended to assess how well the mixture resists common forms of distress. However, BMD lacks consideration of the issues associated with asphalt mixtures produced at production facilities and the effects of placement. Also, there is no widely accepted framework for identifying the combinations of performance tests and procedures for the different applications. There is a need to enhance the BMD process and develop a framework that addresses design, production, and placement of balanced asphalt mixtures. Such a framework should help highway agencies and other organizations evaluate and select balanced asphalt mixtures for use in pavement structure.

OBJECTIVE

The objective of this research is to develop a framework for design, production, and placement of balanced asphalt mixtures. The framework shall focus on enhancing the BMD design process, address the different applications of asphalt mixtures, and delineate the set of performance tests and procedures required for each application. Also, the framework shall address the different applications of asphalt mixtures and delineate the set of performance tests and procedures required for each application.

Accomplishment of the project objective will require at least the following tasks.

TASKS

PHASE I

Task 1. Collect and review domestic and foreign literature, research findings, and information relevant to the performance tests addressing failure modes and procedures (e.g., sampling, aging) that can be used for the design, production, and placement of asphalt mixtures in different applications. This information may be obtained from published and unpublished sources, and from public and private organizations.

Source: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=5505
Source: Recycled Asphalt Binder Study, Wisconsin DOT

Literature Review Findings – Wisconsin DOT Report

Full Blending vs. Black Rock Debate

- ❑ The “full blending” approach
- ❑ The “black rock” approach
- ❑ **The “partial blending” approach**

Practices to Increase RAM Content

- ❑ **Four states require the use of a discount factor of .6 and .85 to account for the “non-active” binders in Recycled Asphalt Materials (RAM)**
- ❑ Incorporation of recycling agents
- ❑ Polymer modification of asphalt binders
- ❑ Utilization of softer asphalt binders
- ❑ Increasing the effective asphalt binder content.

Characterization of Asphalt Binders Containing RAM

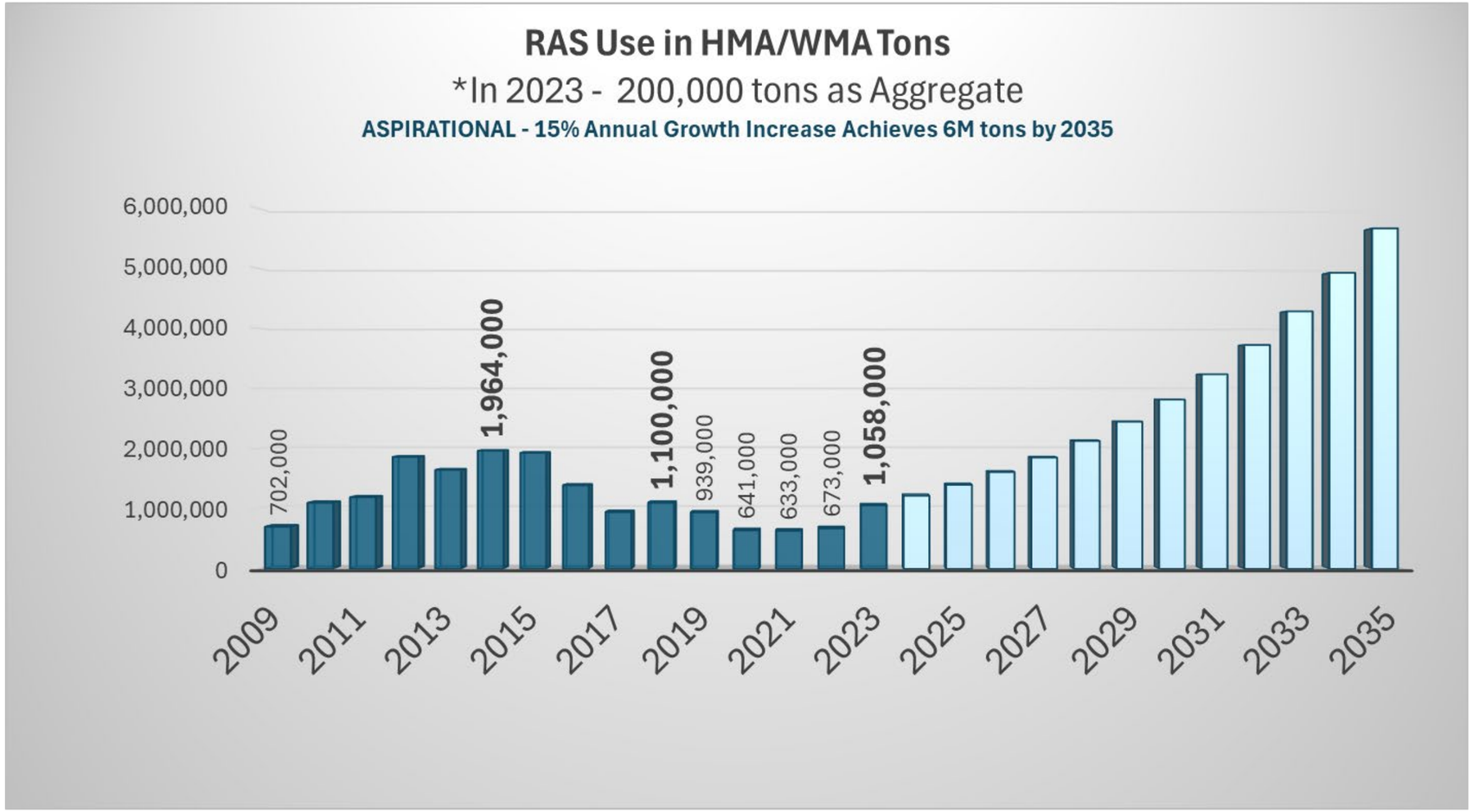
- ❑ Performance of asphalt mixtures containing RAP/RAS is dependent on **the properties of its constitutive components**.
- ❑ The level of blending between the aged and unaged binder is influenced by the chemical composition of the individual binders.
- ❑ **Non-load related cracking** of asphalt pavements (i.e. transverse and block cracks) are **related to oxidation and hardening of the asphalt binder**
- ❑ Classify cracking resistance of asphalt binders using an index parameter. The key parameters used for evaluation of cracking potential of asphalt binders are:
  - From DSR master curves, the G-R parameter;
  - From the LAS test, the Nf (number of cycles to fatigue failure); and
  - From BBR measurements, the creep stiffness (S), m-value, ΔTc and physical hardening.
- ❑ Asphalt binder oxidation has a significant impact on **age-related pavement failure,** Chemical testing to investigate the aging characteristics of asphalt binders.
  - GPC, for evaluation of the molecular size distribution (MSD);
  - DSC, for determination of the glass transition temperature (Tg);
  - FTIR-ATR, for calculation of both carbonyl and sulfoxide groups; and
  - GC-MS, for evaluation of the fatty acid content of recycling agents.

Performance Evaluation of Recycled Asphalt Mixtures

- ❑ Performance in regards to rutting, fatigue cracking, and thermal cracking resistance
  - Dependent of the amount of recycled materials used
  - Type and amount of RA used
    - Rutting resistance increases with an increase in the RAP/RAS content, but tends to decrease with the addition of RAs.
    - Intermediate temperature cracking resistance decreases with an increase in the RAP/RAS content, but may improve with the incorporation of RAs.
  - Reduction of virgin binder grade
    - Low temperature cracking resistance improves when the virgin binder grade is reduced to compensate for the increased stiffness of mixes with high recycled content. In addition, the use of RAs also tends to improve the low temperature properties of recycled mixtures.

Source: Recycled Asphalt Binder Study, Wisconsin DOT

Roofing Industry Aspirations



ASPHALT ROOFING MANUFACTURERS ASSOCIATION

*"The industry aspires to **reduce landfill disposal** of asphalt-based roofing materials to **50% by 2035** and to approach 0% by 2050.*

To accomplish these goals, ARMA will foster and promote responsible, economically feasible, and sustainable circular economy options to recycle asphalt-based roofing materials and enhance the long-term viability of asphalt roofing as the preferred roofing material."

SOURCE: NAPA Asphalt Pavement Industry Survey Recycled Materials and Warm Mix, 2023, Analysis by Dan Horton

Top Roofing Manufacturers North America

End Markets

- ❑ Circularity
  - Asphalt Limestone briquettes
  - roofing granule sand
- ❑ Hot Mix Asphalt
  - Use case to be determined

Location

- ❑ Corsicana, TX
  - 300,000 tons annual capacity
- ❑ $100Million earmarked for expansion

Aspiration

- ❑ 1,000,000 tons by 2030

Challenges

- ❑ Start-up has been slow.

What's Next

- ❑ Expansion in other markets.

SOURCE: https://www.gaf.com/en-us/resources/roofing-technology/asphalt-shingle-recycling?utm_source=chatgpt.com

Top Roofing Manufacturers North America

in

End Markets

- ❑ New shingles
  - Asphalt Limestone briquettes
  - roofing granule sand
- ❑ Asphalt Pavement (BMD driven)
  - Oklahoma DOT Case Study
  - Alabama DOT Case Study

Location

- ❑ Independent Recyclers
- ❑ Redivius Pilot, Indianapolis

Aspiration

- ❑ 2,000,000 tons by 2030

Challenges

- ❑ <3/8” RAS has had performance issues in some states.
- ❑ New extraction process is capital and technology intensive.

What’s Next

- ❑ Balanced Mix Design implementation.

SOURCE: https://roofingmagazine.com/owens-corning-milestone/

Top Roofing Manufacturers North America

RENUCORE by certainteed
certainteed.com/renucore

Addressing the Problems of the Past

	Traditional RAS	vs	RenuCore Pellets
Materials	✓ Low-cost materials		✓ Virgin asphalt replacement
Oxidation	X Extremely hard, oxidized asphalt		✓ PG 85-41 with improved CT index & crack resistance
Feed Rate	X Inconsistent		✓ Feeds like aggregate
Storage	X Reagglomerates		✓ Store indefinitely without agglomerating
Fiberglass	X Airborne		✓ Contained

End Markets

- ❑ Asphalt Pavement (BMD driven)
  - Increased CT Index (cracking resistance)
  - 120+ Useful temperature interval (UTI)
    - PG 85 -41 Post-consumer
    - PG 69 -52 Post-industrial
  - Compared to <3/8” RAS
    - PG151 14 Post-consumer
    - PG120 -13 Post-industrial

Location

- ❑ Independent Recyclers
- ❑ MnRoad Project 2025
- ❑ Washington DOT origins

Aspiration

- ❑ unknown

Challenges

- ❑ Acceptance of process takes time.
- ❑ Recycler, HMA and DOT are part of the sales process.

What’s Next

- ❑ Dedicated sales force seeking opportunities.

Top Roofing Manufacturers North America

End Markets

- ❑ Asphalt Roofing
- ❑ Asphalt Pavement
- ❑ Asphalt pellets, international shipping

Location

- ❑ Established in 2021, Delta, BC
- ❑ Calgary, AB, Canada
  - Operational November 2025
  - 80,000 tons annually

Aspiration

- ❑ International company
- ❑ “Tim Horton’s of Shingle Recycling”

Challenges

- ❑ Extraction facility is more complex than mechanical processing.

What’s Next

- ❑ Frederick, MD
- ❑ 3 additional facilities in the USA

First ASR Facility 2010

End Market

Hot Mix Asphalt Paving

1. **Producing <3/8”** in Bristol, TN
   a) **Servicing rural HMA producers**
   b) Sorting, Grinding, Screening

2. Research and Development Facility
   a) Targeting circularity programs
   b) Developed two raw material approach to shingle recycling
   c) Tested asphaltic powders in various end markets for 5 years

End Market

Asphalt Roofing

Stratford, CT Powder Pilot Plant 2016

Wet Side Powder and Asphalt Blending

Powder & Granule Plant

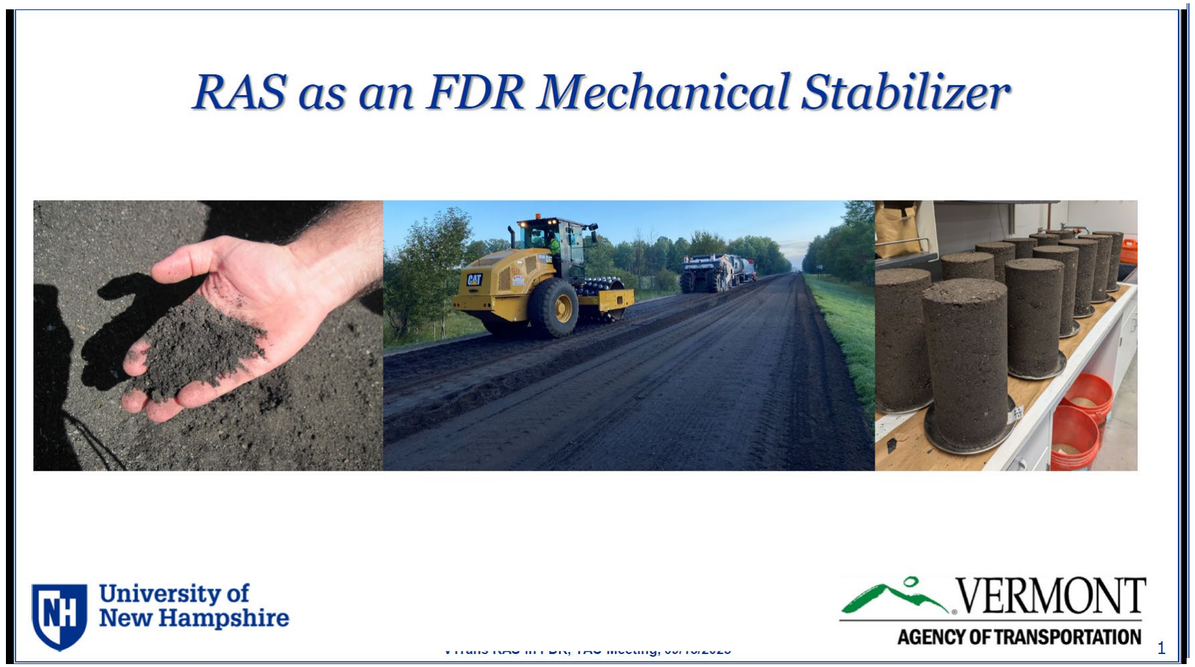
First in North America - Circular Facility

a) Hawkesbury, ON
b) Licensed ASRH Mechanical Processes
c) 2-story 28,000 sq. ft. powder/granule facility
d) Pandemic delayed facility completed winter 2022-23
e) Privately owned company

Dan Horton, founding partner of ASR Systems, a leading pioneer in the development of shingle recycling systems and IKO's partner in this initiative, noted that "IKO is among the first asphalt shingle manufacturers in North America to achieve true circularity at one of its shingle plant locations with an in-line waste recycling process. It is also the first manufacturer, to my knowledge, that has developed a commercialized shingle recycling center that re-uses the recycled raw material output in the production of new shingles."

https://www.iko.com/na/press-releases/asphalt-shingle-recycling-line/

New England Full Depth Reclamation



VTrans Study

- ❑ Support to state-wide landfill ban (on-hold)
- ❑ 2023-2025
- ❑ Report available in the first quarter 2026

Large Volume Usage

- ❑ 5,000-7,000 tons per project

Contact for information

- ❑ To be added to report update list and for a copy

dan.horton@asrsystems.net

Life Cycle Assessment for Recycled Asphalt Shingles Oversight Committee (LROC)

Call for participants at CDRA Annual Conference and Trade Show January 27-29, 2026

Aaron Phillips, ARMA

Shelby Smiley, ARMA

Andrea Johnson, CDRA

Gord Johnson, Northstar Clean Tech

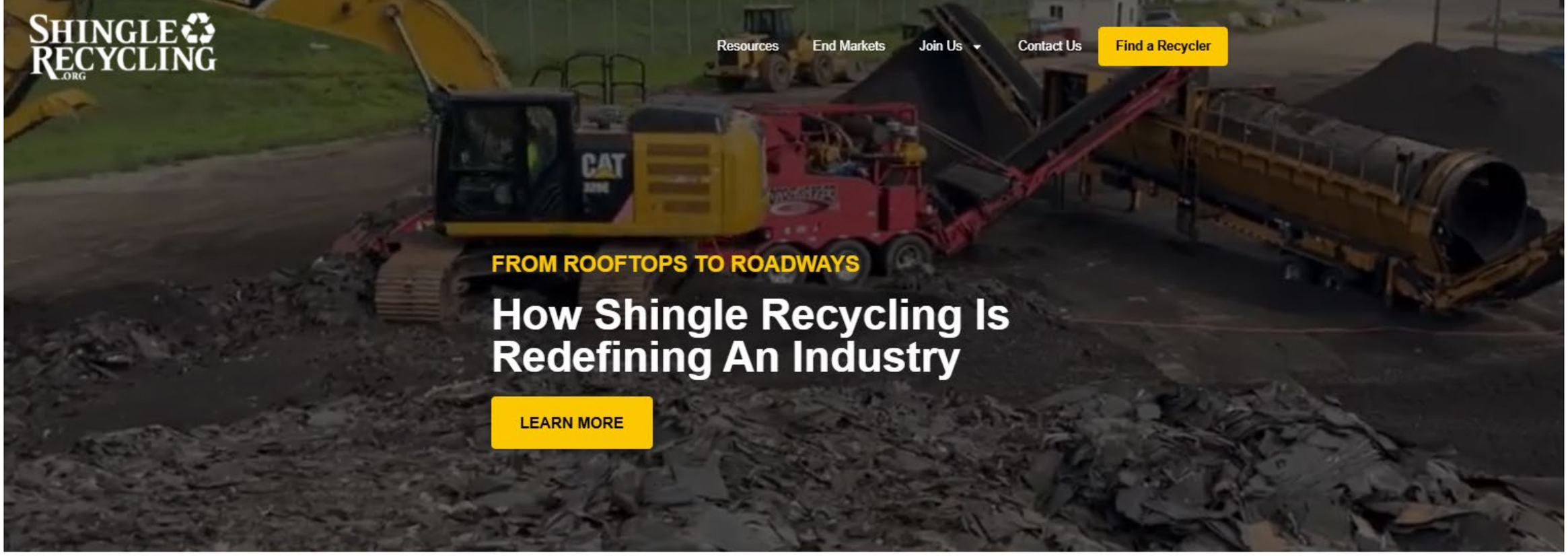
Dan Horton, ASR Systems

Kathy Powles, Falcon Green Resources

Vicki Rybl, WPA

Lianna Miller, WPA

Amlan Mukherjee, NAPA



CDRA Construction & Demolition Recycling Association

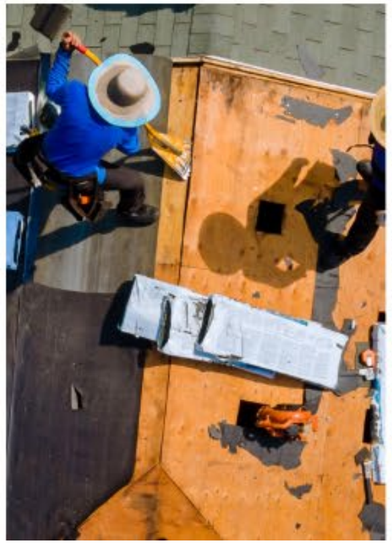
WHO WE ARE

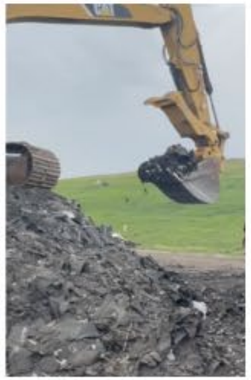
ShingleRecycling.org: The Most Comprehensive Online Resource For Asphalt Shingle Recycling

Millions of tons of asphalt shingle waste end up in our landfills every year, where they can take up to 400 years to decompose.

Beyond the wasteful environmental impacts, this represents an economic opportunity waiting to be seized.

ShingleRecycling.org aims to increase North America's asphalt shingle recycling rate and to be at the forefront of an industry with significant growth potential.





Join Us at the Shingle Recycling Forum
October 13-15, 2026 Raleigh, NC

Thank you!

Dan Horton
401-473-9102
dan.horton@asrsystems.net