Resource Responsible Use of High RAP (up to 50%) Asphalt Mixtures

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Image: Adam Hand

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FHWA is the source for all images unless otherwise noted.

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Acronyms

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- AASHTO = American Association of Highway and Transportation Officials
- BMD = balanced mix design
- COAC = corrected optimum asphalt content
- CO_2e = carbon dioxide equivalents
- DGFC = dense-graded friction course
- FDR = full-depth reclamation
- G_{sa} = apparent specific gravity of the aggregate
- G_{sb} = bulk specific gravity of the aggregate
- GTR = ground tire rubber
- GHG = green house gas
- HP = high polymer
- IS = information series
- MSCR = multiple stress creep compliance
- NAPA = National Asphalt Pavement Association
- NCHRP = National Cooperative Highway Research Program
- OGFC = open-graded friction course
- PMS = pavement management system
- PWL = percent within limits
- QA = quality assurance
- QC = quality control
- RAM = reclaimed asphalt materials
- RAP = reclaimed asphalt pavement
- RAS = recycled asphalt shingles
- RBR = reclaimed binder ratio
- VMA = voids in the mineral aggregate
- WHRP = Wisconsin Highway Research Program
- WMA = warm mix asphalt

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"Development and Deployment of Innovative Asphalt Pavement Technologies"

DDIAPT Innovation Area:

Resource Responsible use of Materials for Flexible Pavement Systems

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Innovation Area	Task	Topic	Tech Brief or Report	FHWA Document
Resource Responsible use of Materials for Flexible Pavement Systems	B.1	High Reclaimed Asphalt Pavement (RAP) Mixtures	Resource Responsible Use of Reclaimed Asphalt Pavement in Asphalt Mixtures	FHWA-HIF-22-003
	B.1.2	Cold & Hot In-place Recycling	Cold Asphalt Recycling & Hot In-place Recycling Best Practices	FHWA-HIF-22-XXX
	B.2	Reclaimed Asphalt Shingles (RAS) Modified Binders and Mixtures	Practices and Lessons Learned when Using Reclaimed Asphalt Shingles in Asphalt Mixtures	FHWA-HIF-22-001
	B.3	Asphalt Rubber-Modified Binders	Effective Use of GTR Modified Asphalt Binder in Asphalt Mixtures	FHWA-HIF-22-011
			Resource Responsible Use of Recycled Tire Rubber in Asphalt Pavements	FHWA-HIF-20-043

https://www.fhwa.dot.gov/pavement/recycling/

Outline

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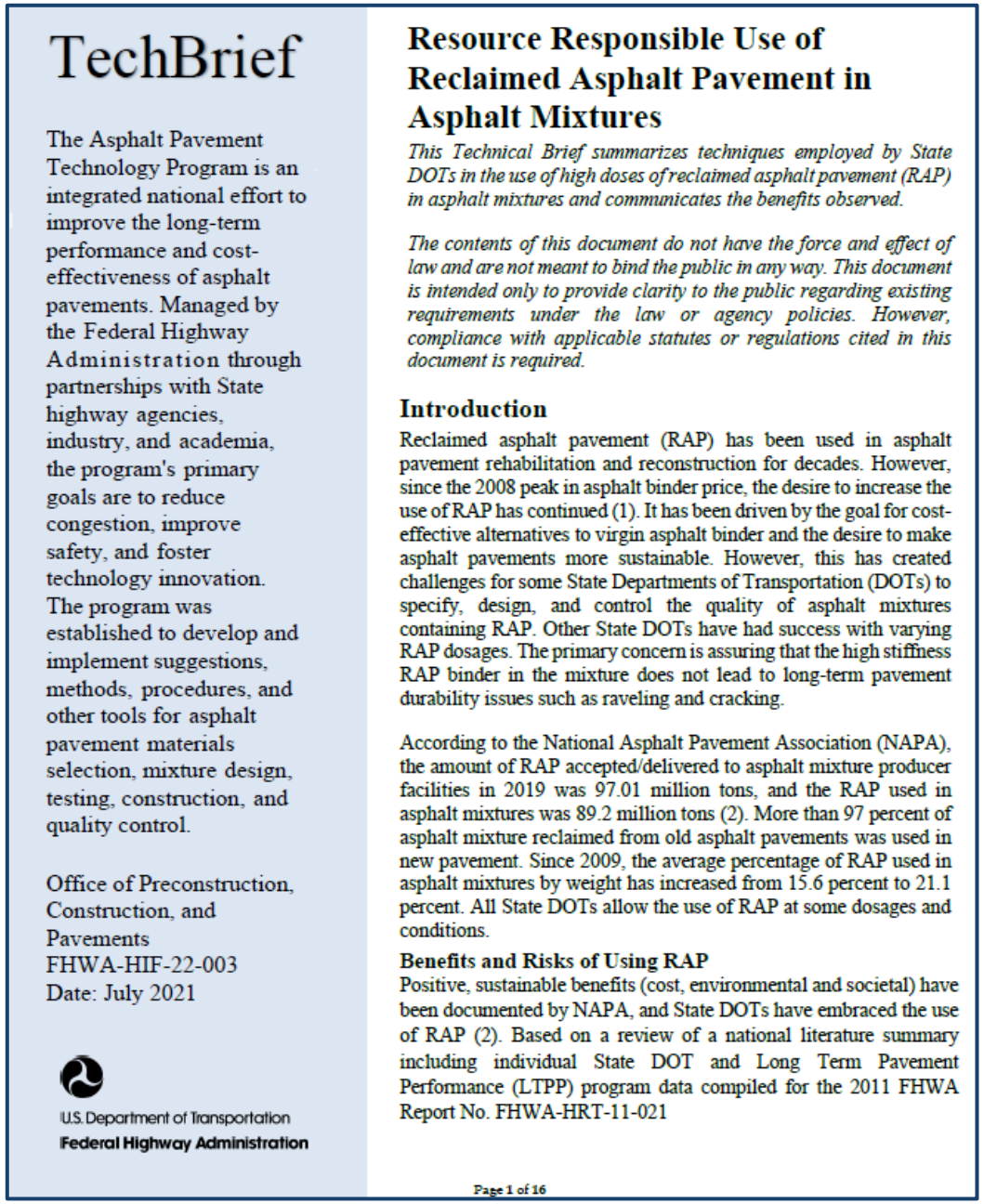

TechBrief

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Office of Preconstruction, Construction, and Pavements
FHWA-HIF-22-003
Date: July 2021

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Resource Responsible Use of Reclaimed Asphalt Pavement in Asphalt Mixtures

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According to the National Asphalt Pavement Association (NAPA), the amount of RAP accepted/delivered to asphalt mixture producer facilities in 2019 was 97.01 million tons, and the RAP used in asphalt mixtures was 89.2 million tons (2). More than 97 percent of asphalt mixture reclaimed from old asphalt pavements was used in new pavement. Since 2009, the average percentage of RAP used in asphalt mixtures by weight has increased from 15.6 percent to 21.1 percent. All State DOTs allow the use of RAP at some dosages and conditions.

Benefits and Risks of Using RAP

Positive, sustainable benefits (cost, environmental and societal) have been documented by NAPA, and State DOTs have embraced the use of RAP (2). Based on a review of a national literature summary including individual State DOT and Long Term Pavement Performance (LTPP) program data compiled for the 2011 FHWA Report No. FHWA-HRT-11-021

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- Performance
- Design Considerations
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- Summary

https://www.fhwa.dot.gov/pavement/recycling/rap.cfm

Why Responsibly Use High RAP?

- Optimize:
  - Cost.
    - Initial and life cycle.
  - Environmental Considerations.
    - Conservation of natural resources.
    - Reduction of CO_2e.
  - Pavement Performance.
    - Equal pavement performance.

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Environment

Performance

Cost Savings

Images: Pixabay

Initial Cost Benefits:
Nebraska DOT

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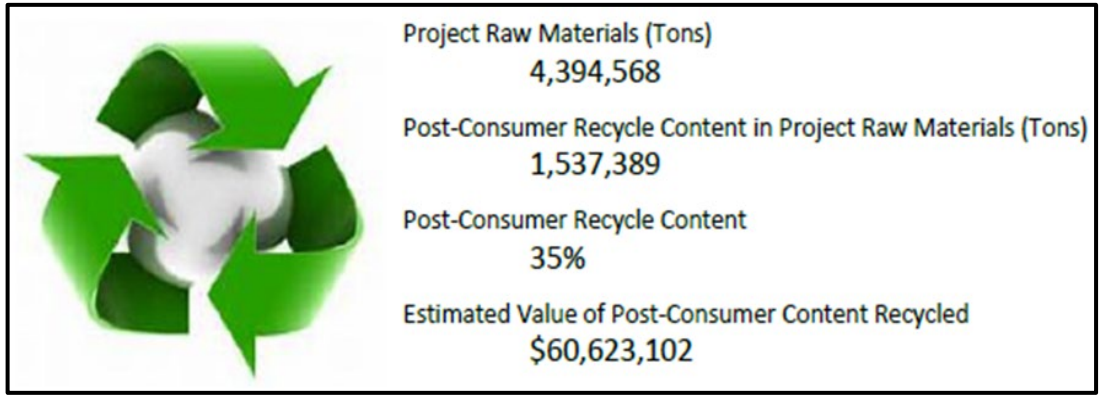
- Nebraska DOT
  - Recycling Goals, Quantities Stated & Cost Savings in Annual Report.
    - https://dot.nebraska.gov/media/3493/annual-report.pdf
  - Saving 2008 to 2020:
    - ≈9.2M tons aggregate recycled.
    - ≈ 498,000 tons asphalt binder recycled.
    - ≈ Cost saving of $408M.
  - Post-Consumer Labeling Plan Sets Since 2014.



Source: Nebraska DOT

Annual Value: $60.6M

Initial Cost Benefits:
Illinois DOT

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Illinois DOT: 2020

- Annual Value: $65,356,915
  - 18% increase from 2019
- Total: 1,439,041 tons
  - 17% increase from 2019
- RAP: 1,113,695 tons
  - 36% increase from 2019
- RAS: 37,655 tons
  - 24% decrease from 2019

Reference: https://bit.ly/3vXNFCT

History of RAP Use:

2021 NAPA IS-138 Annual Survey: RAP, WMA, …

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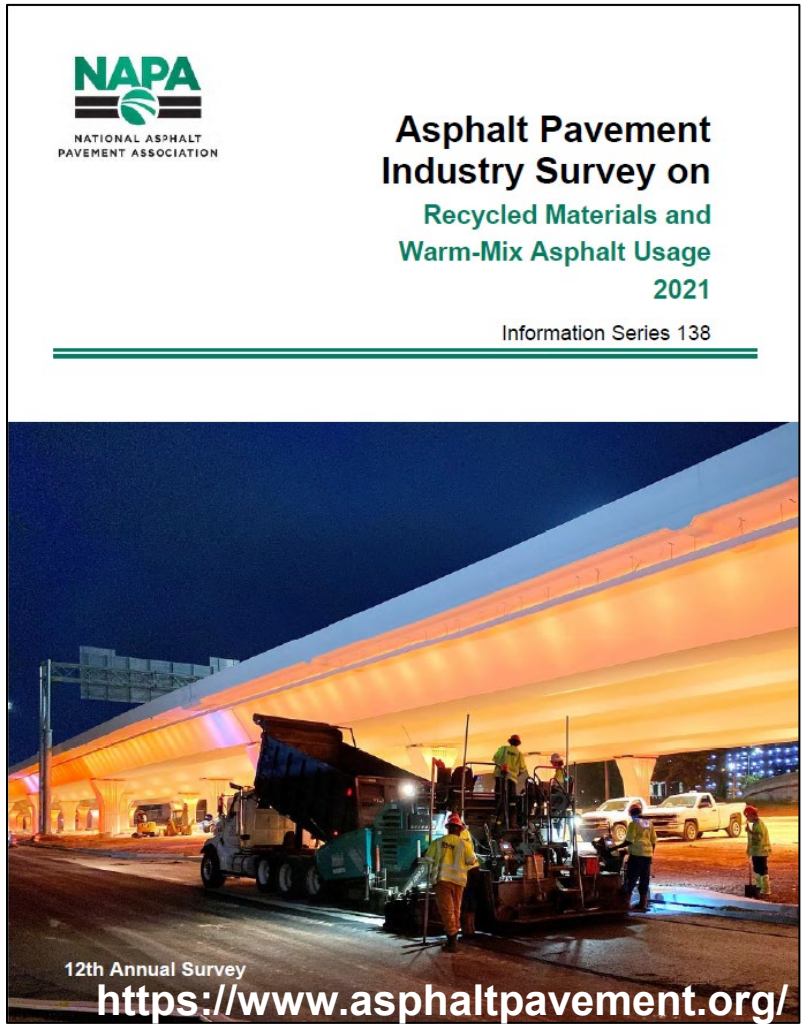
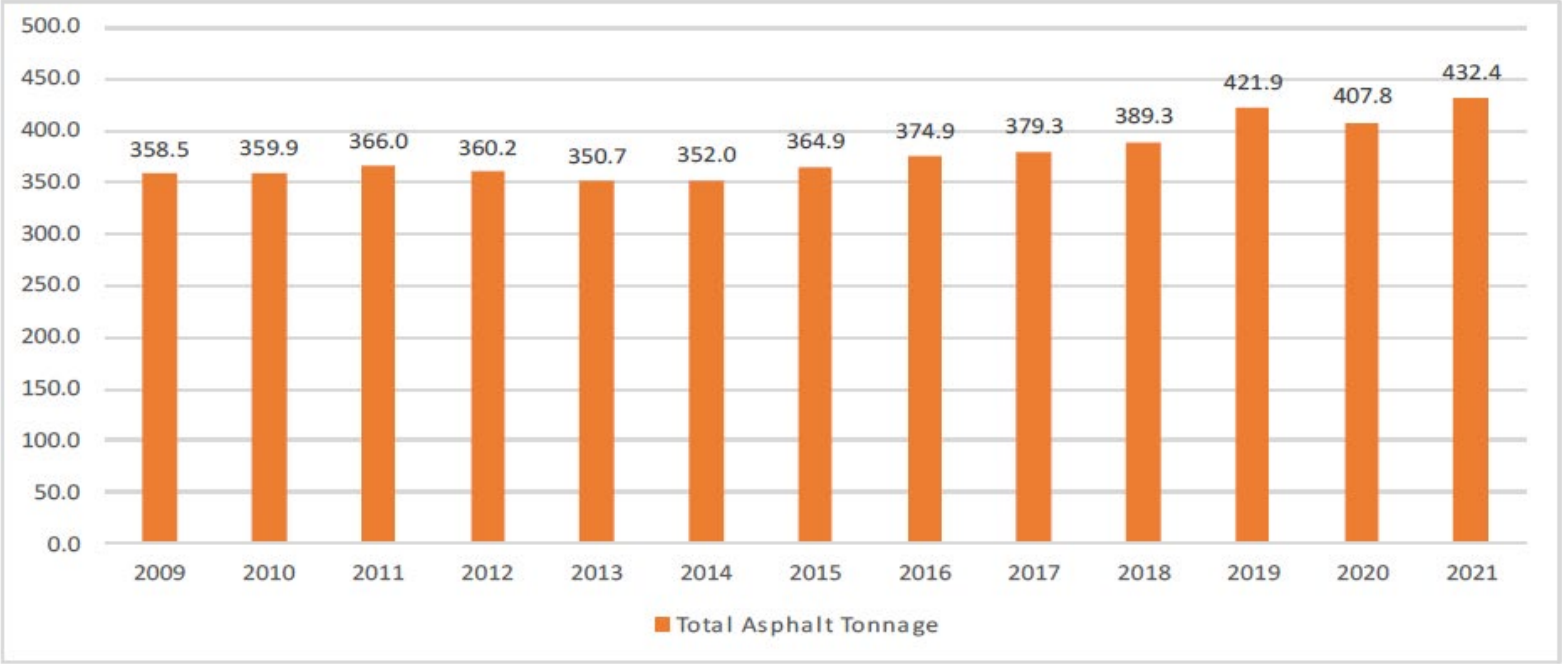
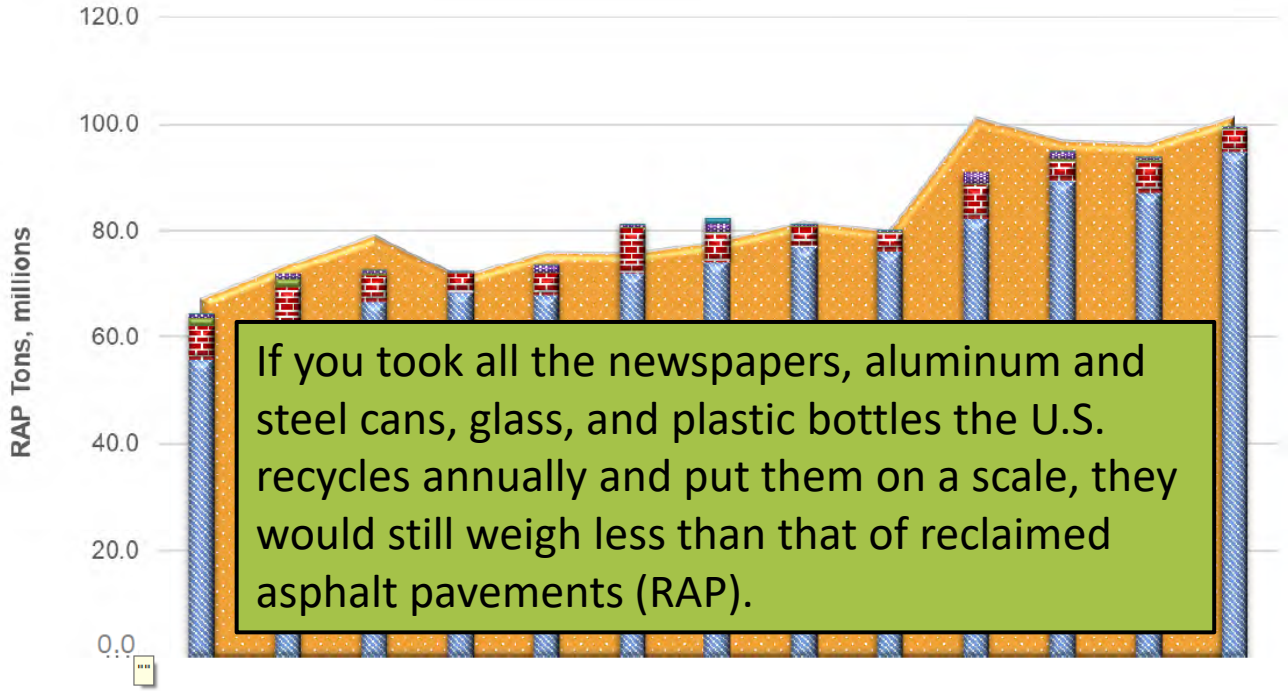




Source: 2021 NAPA IS-138 Annual Survey

Conservation Benefits:

2021 NAPA IS-138, Annual Survey - RAP



If you took all the newspapers, aluminum and steel cans, glass, and plastic bottles the U.S. recycles annually and put them on a scale, they would still weigh less than that of reclaimed asphalt pavements (RAP).

RAP	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Accepted	67.2	73.5	79.1	71.3	76.1	75.8	78.0	81.8	79.9	101.1	97.0	96.3	101.3
Landfilled	0.1	0.0	0.3	0.2	0.1	0.2	1.0	0.1	0.0	0.0	0.1	0.2	0.1
Used in Other	0.7	0.8	0.7	0.2	1.5	0.6	1.6	0.4	0.2	2.0	1.4	0.3	0.2
Used in Cold Mix	1.5	1.6	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.1
Used in Aggregate	6.2	7.3	4.9	3.6	4.0	8.5	5.5	3.7	3.4	6.4	3.8	5.8	4.2
Used in HMA/WMA	56.0	62.1	66.7	68.3	67.8	71.9	74.2	76.9	76.2	82.2	89.2	87.0	94.6

Figure 3: Comparison of Tons of RAP Accepted and Tons of RAP Used or Landfilled (Million Tons), 2009–2021

Source: 2021 NAPA IS-138 Annual Survey

Trends:

- Most recycled material.
- ≈93% of RAP put back in new asphalt mixture.
- Annual savings:
  - 4.7M tons of asphalt binder (24M barrels).
  - 90M tons of aggregate.
  - $3.5 billion.

Carbon Reduction Benefits:

2021 NAPA IS-138, Annual Survey - RAP

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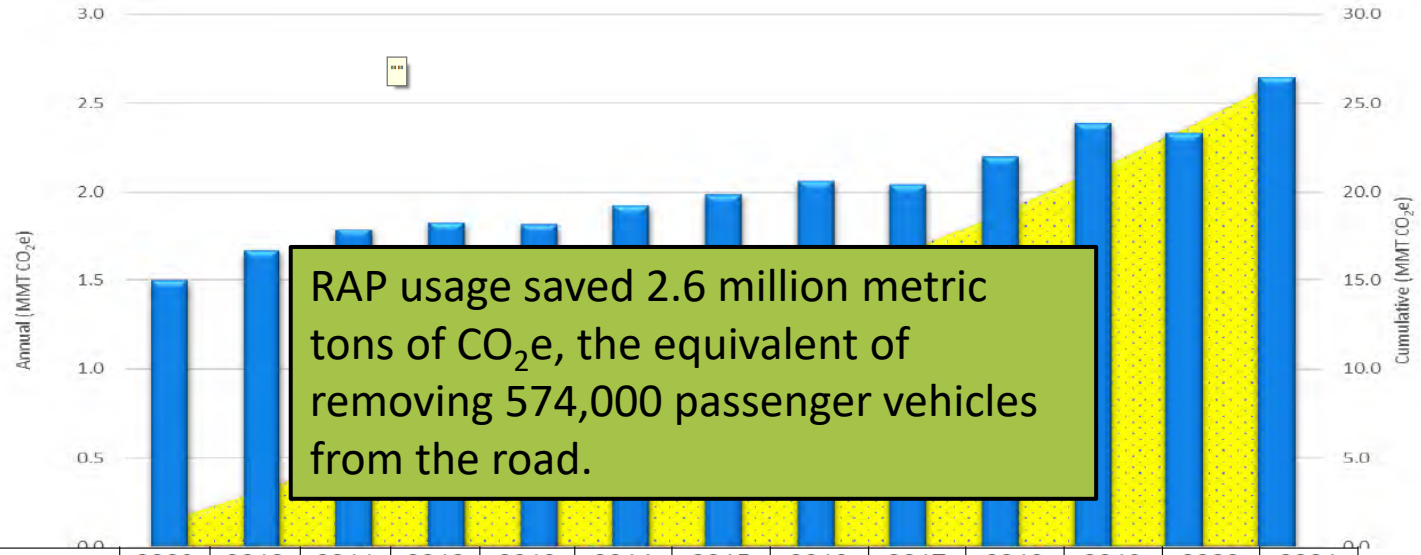
Figure 19: GHG Emissions Reduction from Use of RAP in New Asphalt Mixtures, 2009–2021



RAP usage saved 2.6 million metric tons of CO_2e, the equivalent of removing 574,000 passenger vehicles from the road.

GHG Emissions	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Cumulative	1.5	3.2	4.9	6.8	8.6	10.5	12.5	14.5	16.6	18.8	21.2	23.5	26.1
Annual	1.5	1.7	1.8	1.8	1.8	1.9	2.0	2.1	2.0	2.2	2.4	2.3	2.6

Trends:

- Steady reduction of GHG emissions (tons CO_2e).
  - 2021: 2.6 MMT.
  - 2009: 1.5 MMT.
  - 2009 to 2021: 26.1 MMT.

Source: 2021 NAPA IS-138 Annual Survey

Virtual Site Visits

- **Florida DOT (FDOT)**:
  - Unlimited RAP use for some mixture types.
  - Several producers use 40% RAP, One uses 50% in unlimited RAP mixture type.
- **Nebraska DOT (NDOT):**
  - Averaged 39% RAP use for the past 6 years.
  - Typical RAP range 35 to 50%.
- **New Jersey (NJDOT):**
  - High RAP specification: Min 20% RAP surface mixtures; 30% intermediate and base mixtures using BMD approach.
- **South Carolina DOT (SCDOT):**
  - Some mixtures with 25 to 35% RAP.
  - Alternative RAP uses, e.g. full-depth reclamation (FDR).
- **Washington DOT (WSDOT):**
  - Up to 40% RBR (≤20% from RAS).
  - Uses BMD approach.
- **Wisconsin DOT (WisDOT):**
  - >95% of 2.8 million tons of asphalt contains RAP.
  - 40% RAP in some mixtures.

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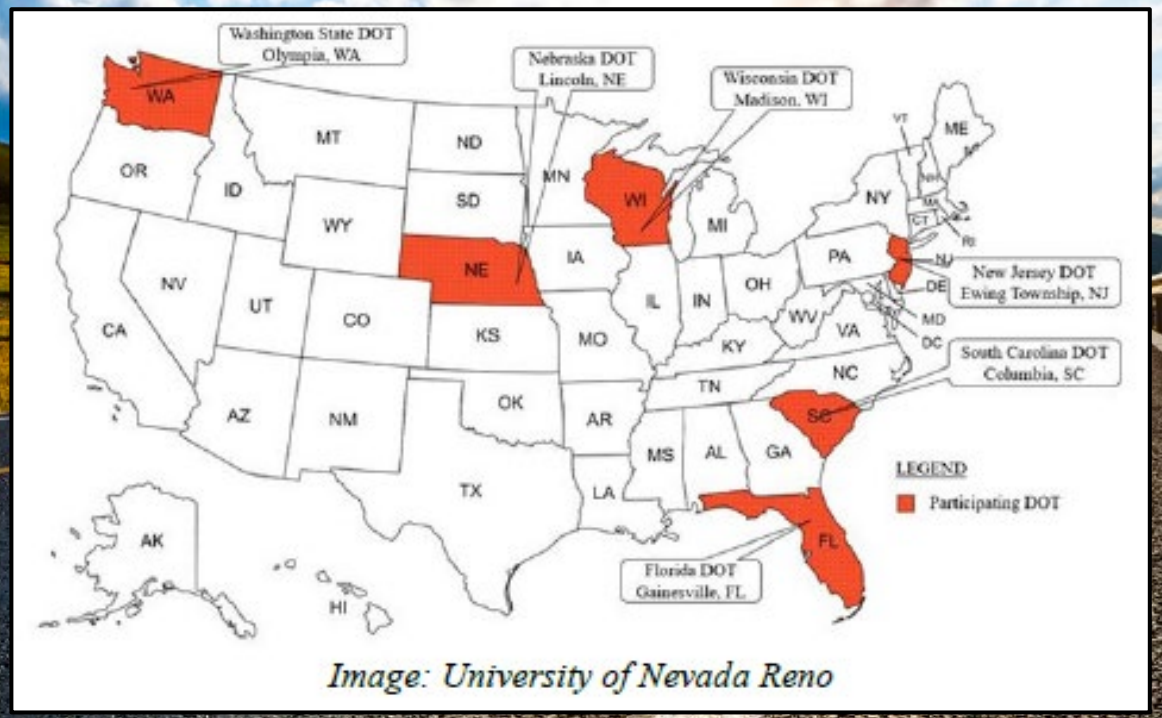

Image: University of Nevada Reno

Outline

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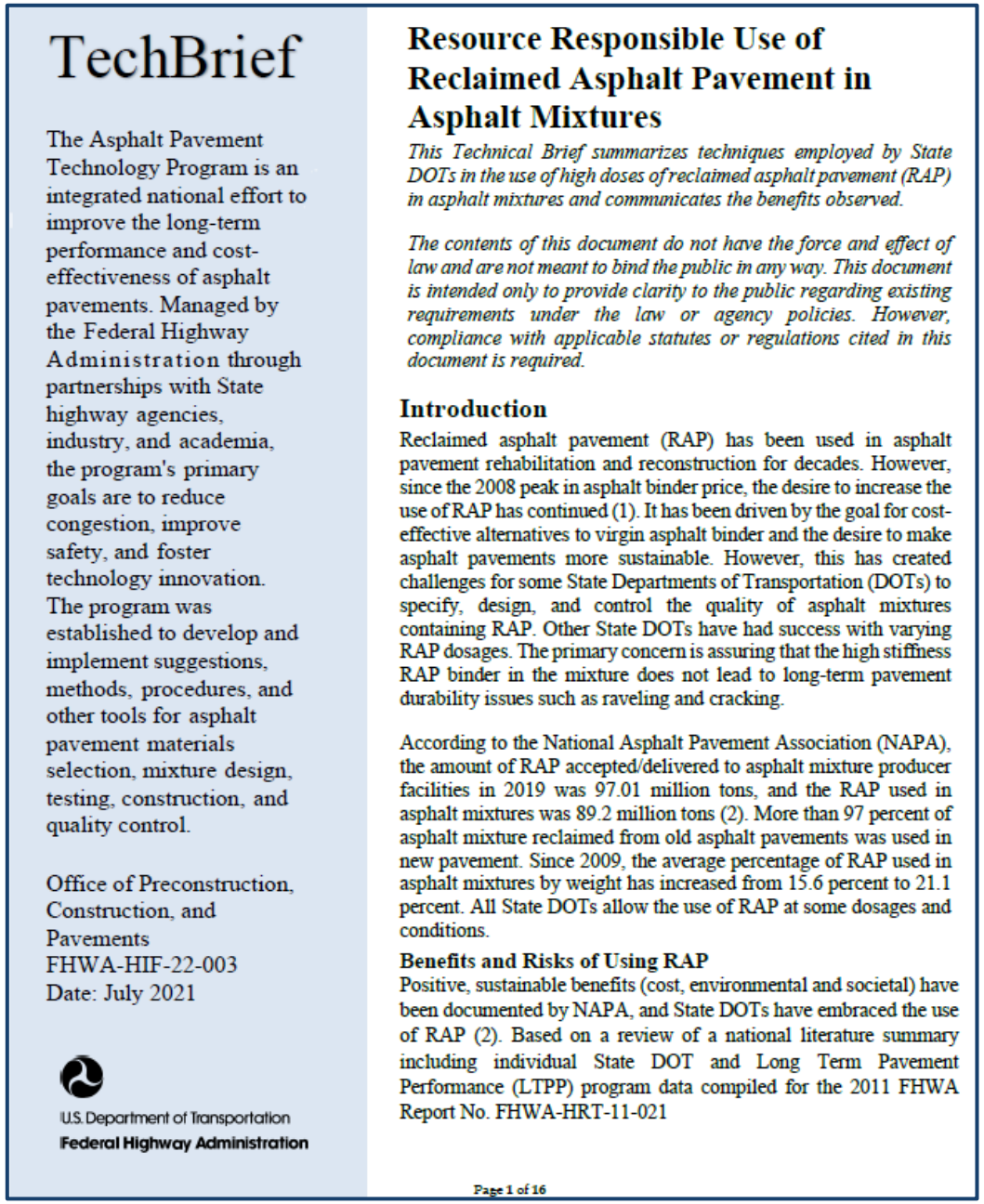

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https://www.fhwa.dot.gov/pavement/recycling/rap.cfm

Nebraska DOT Pavement Performance Observations

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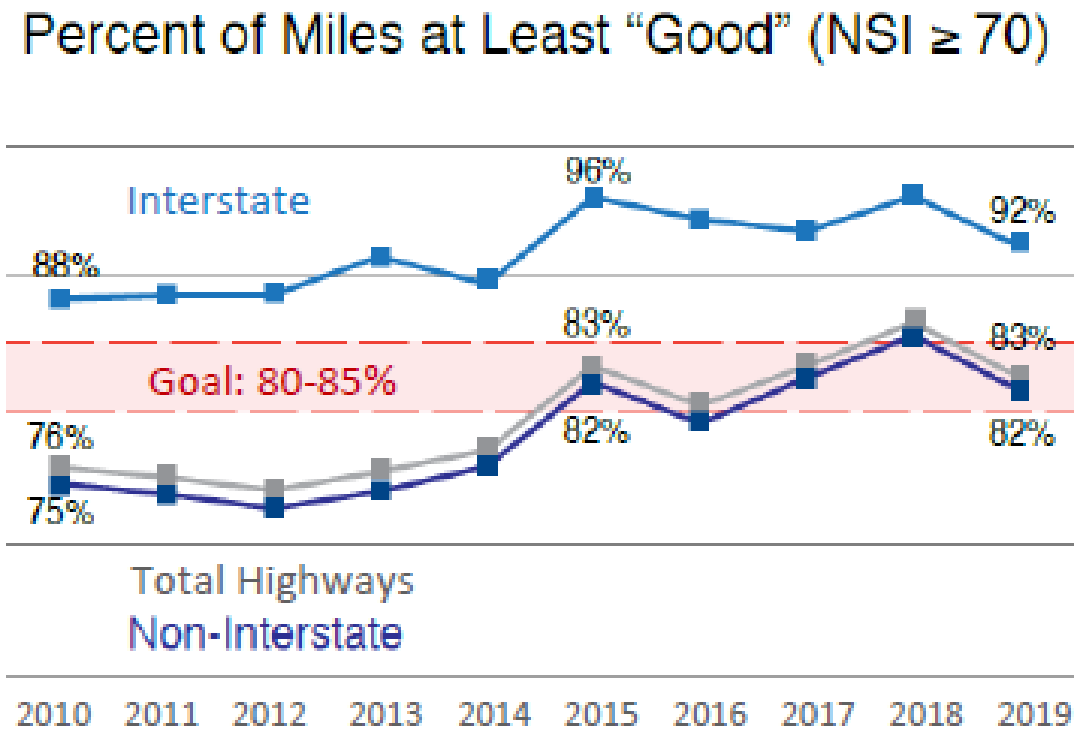
- Nebraska Serviceability Index (NSI):
  - Range = 0 to 100.
  - "Good" ≥ 70%.
- Goal 80 to 85% of Highway System "Good:"
  - 92% of Interstate System "Good."
  - 83% of Total Highway System "Good."
- NSI has Increased since High RAP Implementation in 2013.



Source: Nebraska DOT

Pavement Performance with RAP

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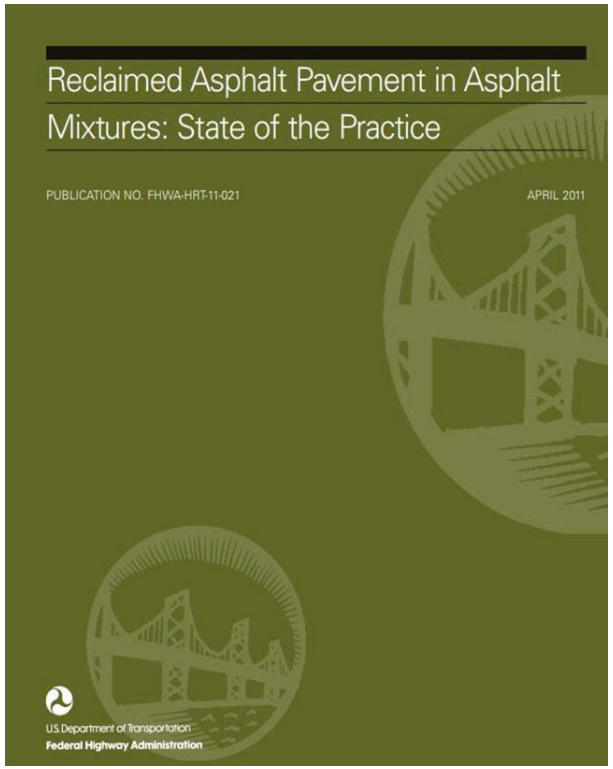
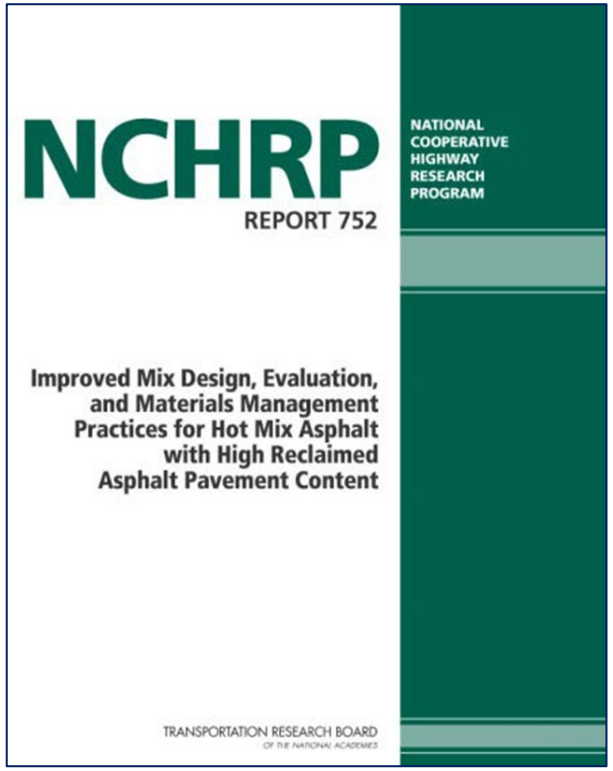
- RAP in Asphalt Mixtures: State of the Practice.
  - FHWA Publication: FHWA-NRT-11-021.



- NCHRP Report 752.
- NCAT Test Track.
- LTPP Studies.



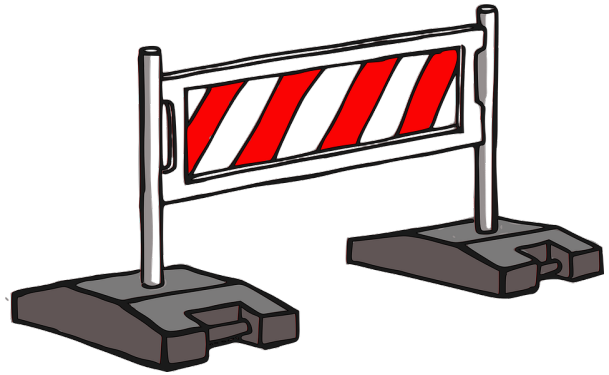


Image: Pixabay

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Design Considerations

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Criteria Commonly Used:

1. Project selection:
   a) Lift, traffic, mix type.
   b) RAP limits.
2. Softer binder.
3. Additional asphalt content.

Criteria Sometimes Used:

- Recycling agents.
- Mixture performance test.

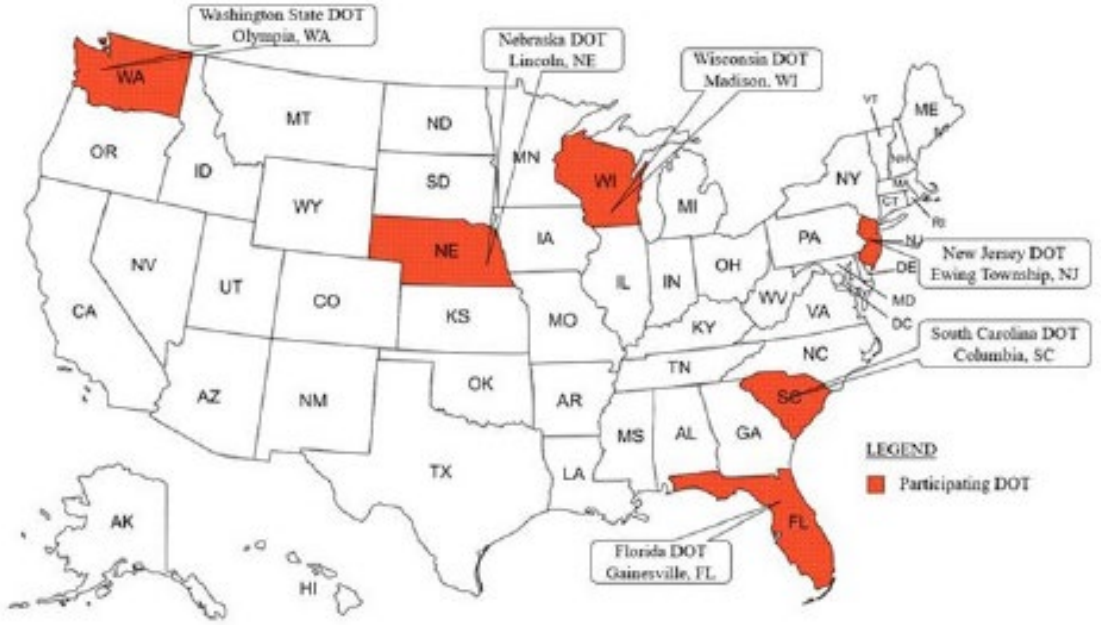

Image: University of Nevada Reno

1. Project Selection

Florida DOT Example:

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%RAP = f(mix type, location, binder type, and geographic location).

- Unlimited RAP:
  - Intermediate and base mixes with neat binders.
- 20% RAP:
  - Dense-graded friction course (DGFC) with granite aggregate.
  - All intermediate mixes with PG 76-22.
- 0% RAP:
  - Dense-graded friction course (DGFC) mixes with South Florida limestone.
  - OGFC or High Polymer (HP).

2. Softer Binder

State	Softer Binder	Blending Chart	PG of Blended Asphalt
FDOT	One to two PG bumps down based on RAP dose.		
NDOT	Low PG bumped down one grade. Only MSCR grades are specified.		
NJDOT	Contractor selects. Must meet mixture performance test.		
SCDOT			
WisDOT		Only to demonstrate that at higher RBR, blended binder meets the specified PG for the project per AASHTO M 332.	Only to demonstrate that at higher RBR, blended binder meets the specified (PG) for the project per AASHTO M 332
WSDOT			For all mixes containing RAS or > 20% RAP.

2. Softer Binder

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- Florida DOT
  - 0-15% RAP – PG 67-22.
  - 16-30% RAP – PG 58-22.
  - >30% RAP – PG 52-28 .
  - Plus safeguards.
- Nebraska DOT
  - Low temperature bumped from -28 to -34.
  - MSCR grading with percent recovery for polymer modified binders.

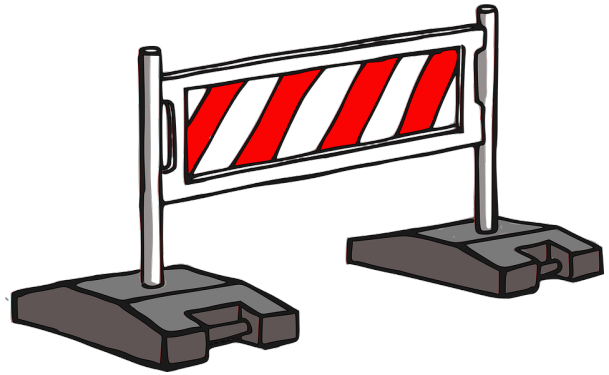

Image: Pixabay

2. Softer Binder

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- Wisconsin DOT (WHRP 11-13)

Recycled Asphaltic Material	Location in Pavement Structure and Allowable RBR	
	Lower Layers (RBR %)	Upper Layers (RBR %)
RAS if used alone	25	20
RAP and FRAP in any combination	40	25
RAS, RAP, and FRAP in combination [1] [2]	35	25

Maximum Allowable Percent Binder Replacement.

[1] *When used in combination the RAS component cannot exceed 5 percent of the total weight of the aggregate blend.*

[2] *The maximum allowable percent binder replacement, from RAS, RAP, and FRAP in combination, in an SMA mixture is 15 percent.*

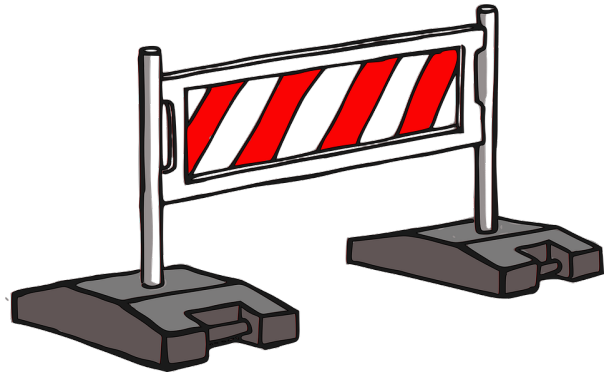

Image: Pixabay

3. Additional Asphalt Content

State	FDOT	NDOT	NJDOT	SCDOT	WisDOT	WSDOT
Regressed Design %AV		1.5-4%		3.0-4.0%	≥3.0%	
Minimum %AC		X				
Minimum %VMA > AASHTO M323			+1.0%	+0.5%*	+0.5%	
Asphalt Binder Separate Pay Item			X	X		
Performance Tests			Rutting, Cracking	Rutting		Rutting, Cracking
Other			Max %Gsa	COAC	Gsb of RAM aggs	Gsb of RAM aggs

*Uses G_{se} but have low absorptive aggregates

Use of Additives

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- Recycling Agents.
  - NJDOT and WSDOT allow recycling agents at Contractor's option:
    - NJDOT to meet high RAP mixture performance test requirements.
    - WSDOT to meet blended binder (virgin, RAP, and recycling agent) PG requirements.
  - NDOT researching recycling agents for high recycled mixtures to "-40" PG binder.
- WMA
  - NDOT requires the use of an approved WMA additive.

Mixture Performance Tests

State	FDOT	NDOT	NJDOT	SCDOT	WisDOT	WSDOT
Rutting Test			APA	APA		HWT
Cracking Test			TxOL			IDT
Mixture Design			APA and TxOL	APA		HWT and IDT
Test Strip			APA and TxOL	APA		IDT
Production or Acceptance			APA and TxOL			1/10,000 tons
Test(s) of Interest	IDEAL-CT	HWT, SCB		HWT, IDEAL-CT	HWT, IDEAL-CT	HWT, IDEAL-CT

Outline

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Federal Highway Administration

TechBrief

The Asphalt Pavement Technology Program is an integrated national effort to improve the long-term performance and cost-effectiveness of asphalt pavements. Managed by the Federal Highway Administration through partnerships with State highway agencies, industry, and academia, the program's primary goals are to reduce congestion, improve safety, and foster technology innovation. The program was established to develop and implement suggestions, methods, procedures, and other tools for asphalt pavement materials selection, mixture design, testing, construction, and quality control.

Office of Preconstruction, Construction, and Pavements
FHWA-HIF-22-003
Date: July 2021

U.S. Department of Transportation
Federal Highway Administration

Resource Responsible Use of Reclaimed Asphalt Pavement in Asphalt Mixtures

This Technical Brief summarizes techniques employed by State DOTs in the use of high doses of reclaimed asphalt pavement (RAP) in asphalt mixtures and communicates the benefits observed.

The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies. However, compliance with applicable statutes or regulations cited in this document is required.

Introduction

Reclaimed asphalt pavement (RAP) has been used in asphalt pavement rehabilitation and reconstruction for decades. However, since the 2008 peak in asphalt binder price, the desire to increase the use of RAP has continued (1). It has been driven by the goal for cost-effective alternatives to virgin asphalt binder and the desire to make asphalt pavements more sustainable. However, this has created challenges for some State Departments of Transportation (DOTs) to specify, design, and control the quality of asphalt mixtures containing RAP. Other State DOTs have had success with varying RAP dosages. The primary concern is assuring that the high stiffness RAP binder in the mixture does not lead to long-term pavement durability issues such as raveling and cracking.

According to the National Asphalt Pavement Association (NAPA), the amount of RAP accepted/delivered to asphalt mixture producer facilities in 2019 was 97.01 million tons, and the RAP used in asphalt mixtures was 89.2 million tons (2). More than 97 percent of asphalt mixture reclaimed from old asphalt pavements was used in new pavement. Since 2009, the average percentage of RAP used in asphalt mixtures by weight has increased from 15.6 percent to 21.1 percent. All State DOTs allow the use of RAP at some dosages and conditions.

Benefits and Risks of Using RAP

Positive, sustainable benefits (cost, environmental and societal) have been documented by NAPA, and State DOTs have embraced the use of RAP (2). Based on a review of a national literature summary including individual State DOT and Long Term Pavement Performance (LTPP) program data compiled for the 2011 FHWA Report No. FHWA-HRT-11-021

Page 1 of 16

- Introduction and Background
- Performance
- Design Considerations
- Construction and QA
- Summary

https://www.fhwa.dot.gov/pavement/recycling/rap.cfm

Quality Assurance:
QC

U.S. Department of Transportation
Federal Highway Administration

- Required QC Plan (FDOT, NDOT, NJDOT, SCDOT).
  - Submitted with mix design.
  - Where is RAP coming from?
  - How is it processed?
  - How is the quality measured?
- Contractor process control and QC.
  - Each asphalt plant has an on-site QC lab.
  - Consistency: blending, screening, crushing over-size materials, and stockpiling.
- Allowing fractionation of RAP (FDOT, SCDOT, WisDOT).

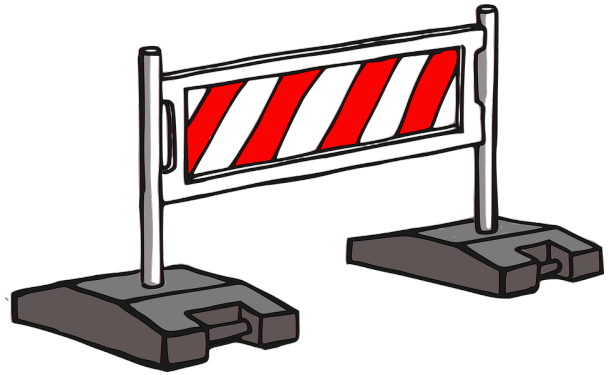

Image: Pixabay

Quality Assurance:
Acceptance

- Dedicated RAP stockpiles (FDOT, SCDOT, WSDOT).
- PWL acceptance specifications (FDOT, WisDOT, WSDOT).
- Mixture performance tests during test strips and acceptance (NJDOT, WSDOT).

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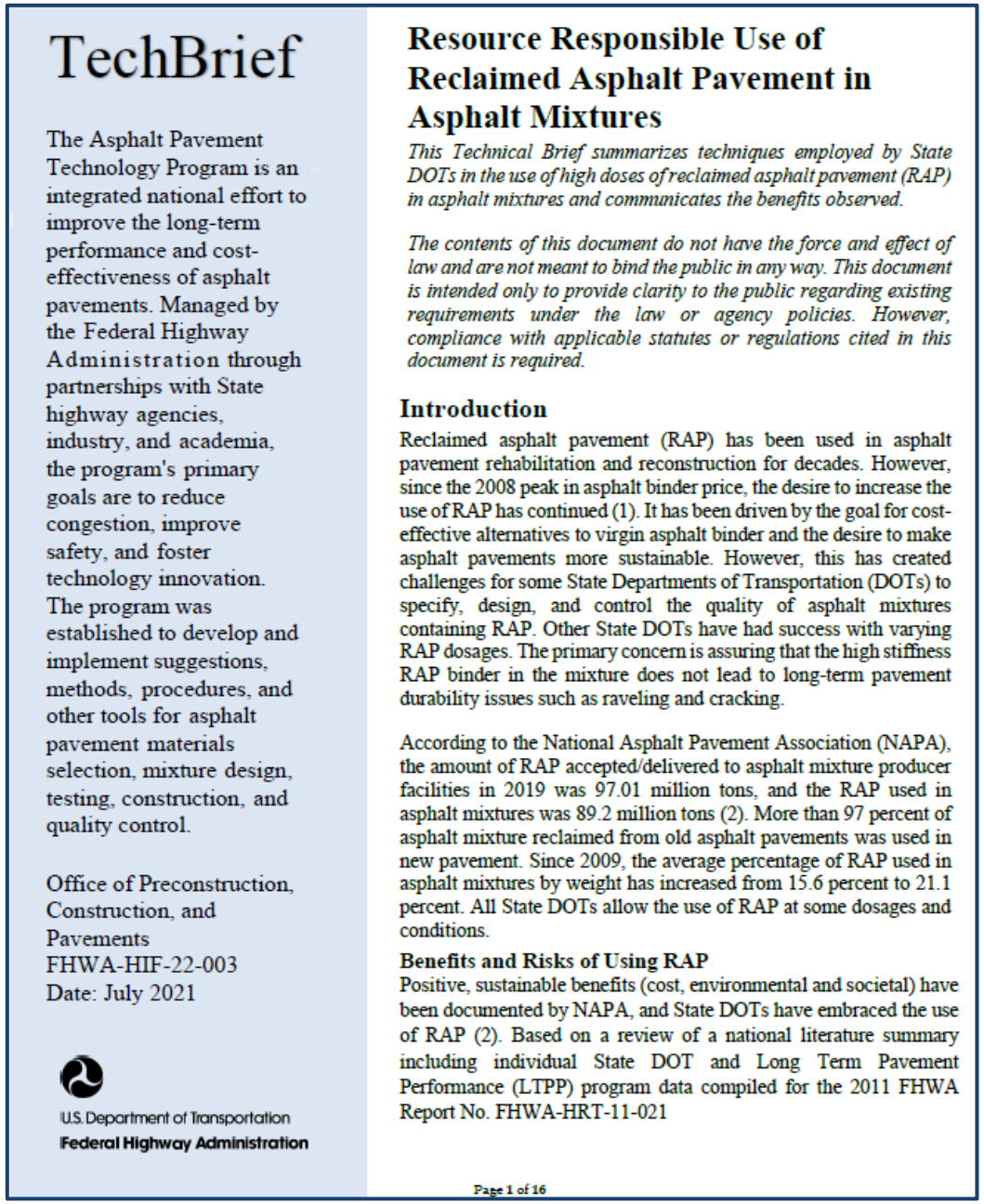
Outline

U.S. Department of Transportation
Federal Highway Administration



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Summary

Overview

U.S. Department of Transportation
Federal Highway Administration

- NAPA reports about 20% RAP typical, participating State DOTs reported success with 30-50% RAP.
- Sustainable benefits: *Cost, Environmental & Societal.*
- Good pavement performance accomplished through:
  - Monitoring pavement performance.
  - Reviewing regularly DOT specifications, mixture design procedures, & performance test methods.
  - Working with asphalt producers for improvement.
  - Performing research as a basis for changes.

Resource Responsible use of Materials for Flexible Pavement Systems

Summary

Path Forward

- Design Considerations.
  - Project selection.
    - Lift, traffic, mix type.
    - RAP limits.
  - Softer binder.
  - Additional asphalt content.
  - Criteria sometimes used:
    - Recycling agents.
    - Mixture performance test.
- Construction and Quality Assurance.
  - Quality Assurance: QC plans and acceptance.
- Research and Training Needs.

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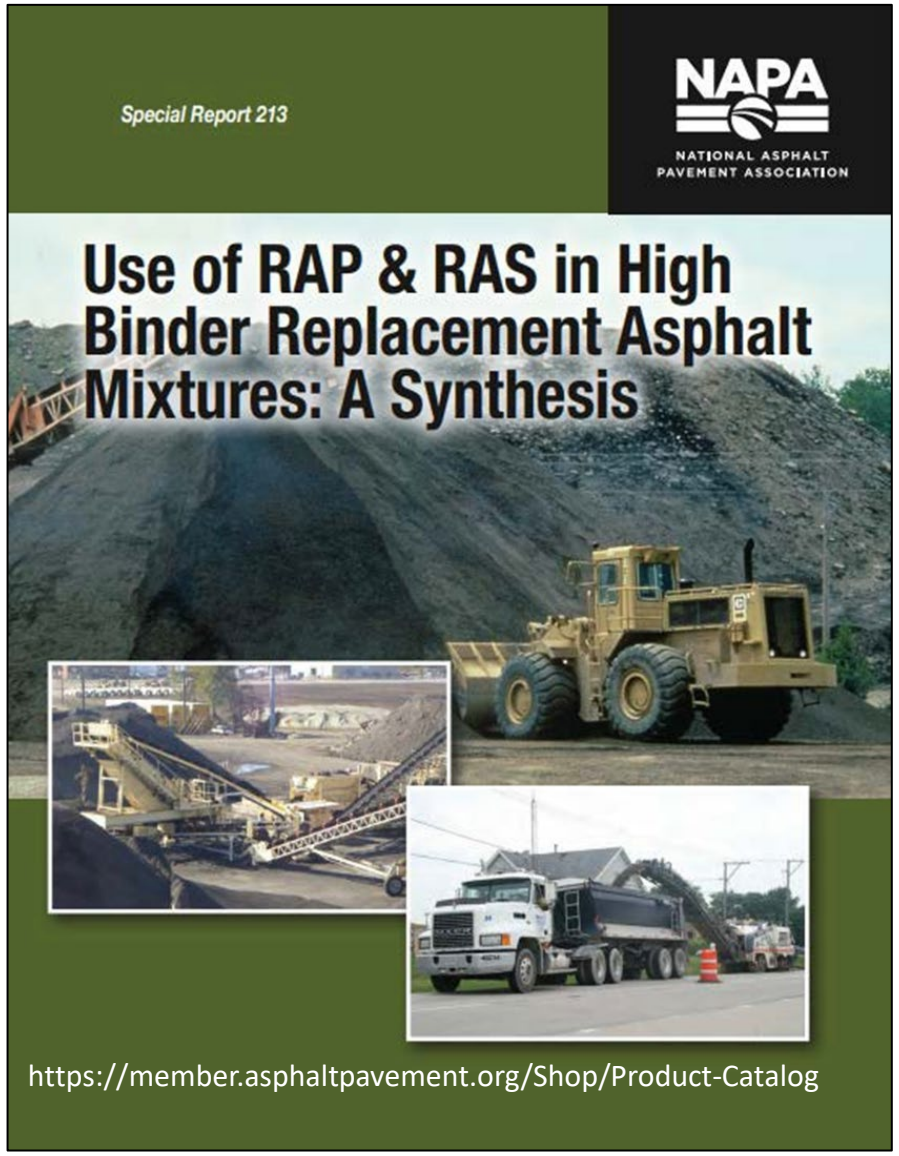
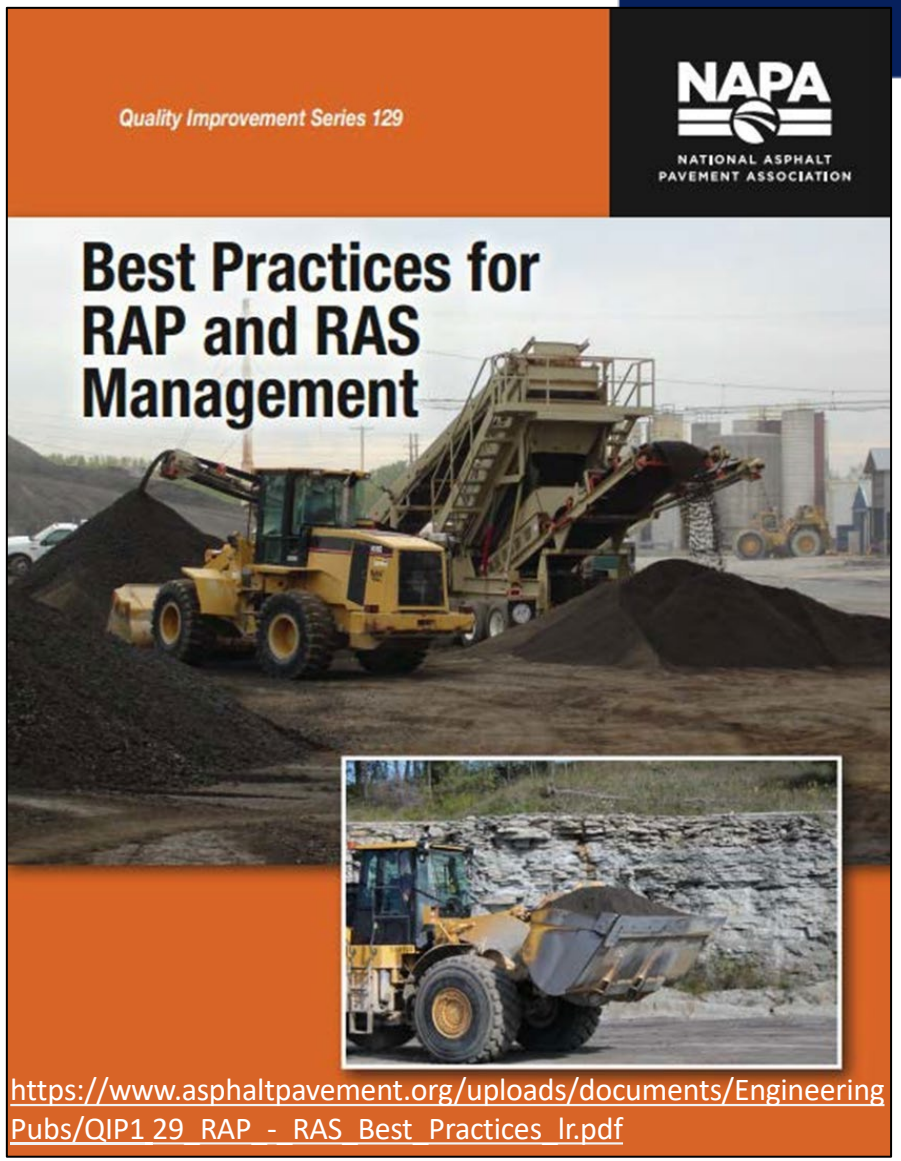
Federal Highway Administration

Resources

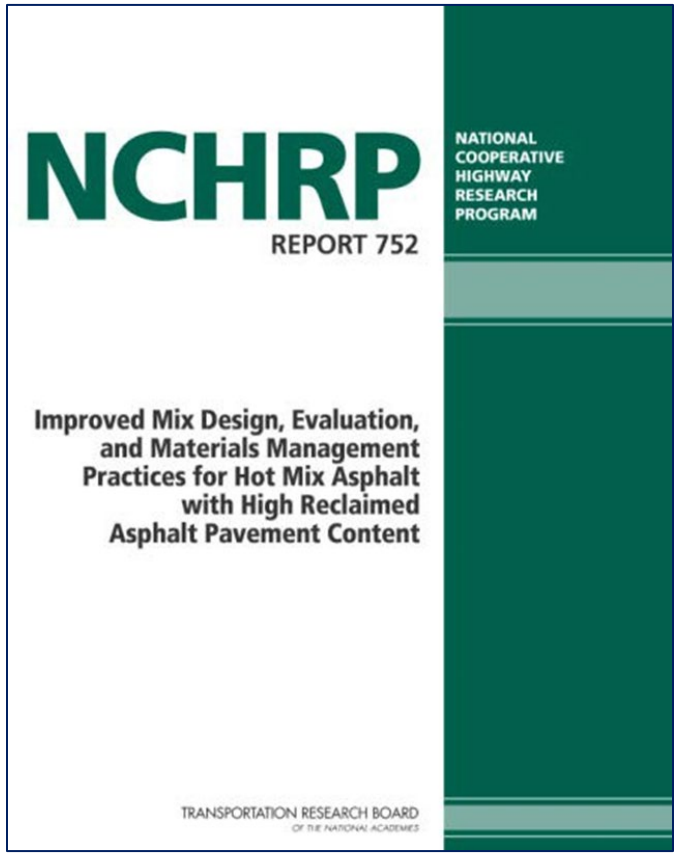


https://member.asphaltpavement.org/Shop/Product-Catalog

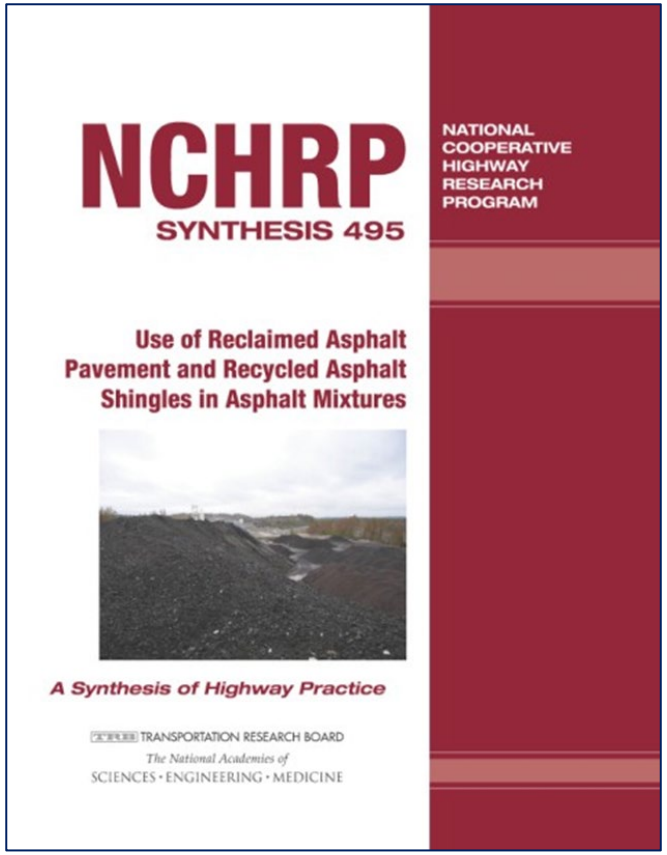


https://www.asphaltpavement.org/uploads/documents/EngineeringPubs/QIP1 29_RAP_-_RAS_Best_Practices_lr.pdf

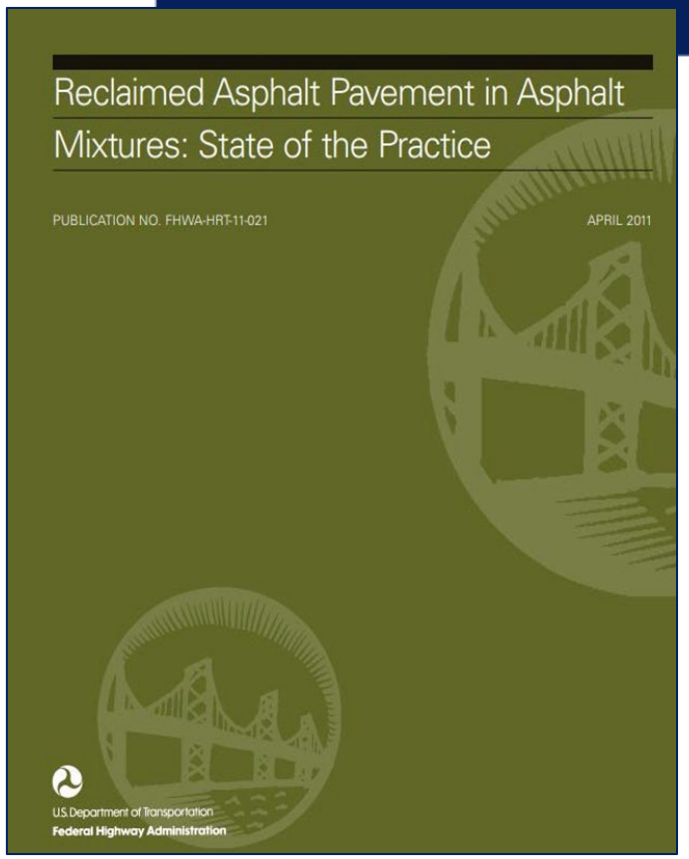
Resources



https://www.nap.edu/catalog/22554/improved-_mix-design-evaluation-and-materials-management-practices-for-hot-mix-asphalt-with-_high-reclaimed-asphalt-pavement-content



http://www.trb.org/Publications/Blurbs/174969.a_spx



https://www.fhwa.dot.gov/publications/research/infrastructure/pavements/11021/11021.pdf

Resources

U.S. Department of Transportation
Federal Highway Administration

Pavements

Design & Analysis | Materials Quality Assurance | Sustainability | Pavement Management & Performance | Pavement & Materials

Recycling | Sustainable Pavement Program | Warm Mix Asphalt

APIPRT | GTR | RAP | RAS | Concrete

Home / Programs / Pavements / Sustainability / Recycling

Recycling

FHWA Recycling Policy

FHWA Recycled Materials Policy

FHWA recognize the need to increase our highway industry's overall use of recycled materials. There are several benefits to recycling:

- Cost savings potential
- life cycle cost and engineering performance
- Reduction in landfill
- Stewardship of our environment

FHWA's Recycling Policy has several key points:

- Recycling can offer engineering, economic and environmental benefits.
- Recycled materials should get first consideration in overall materials selection.
- Engineering and environmental properties are important.
- Life Cycle Cost benefits assessment is warranted.
- Restrictions prohibiting recycled material that are without technical basis should be removed.

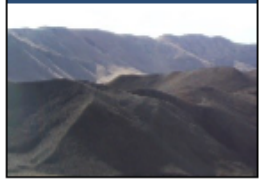
The complete FHWA Recycled Materials Policy is available

Asphalt Recycling

Asphalt Pavement In-place Recycling Technologies (APIPRT)

Ground Tire Rubber (GTR)

Reclaimed Asphalt Pavement (RAP)



Recycled Asphalt Shingles (RAS)

Concrete Recycling

Additional Resources

- https://cptechcenter.org/concrete-recycling/
- FHWA Cooperative Agreement with University of Nevada Reno (UNR) has a website with recycling information: https://www.unr.edu/wrsc/tools/asphalt
- NAPA recycled materials usage report: https://www.asphaltpavement.org/expertise/sustainability/sustainability-resources/recycling

Focus Articles:

FHWA Website:
https://www.fhwa.dot.gov/pavement/recycling/

Thank You

Q & A

Tim Aschenbrener

Federal Highway Administration

Timothy.aschenbrener@dot.gov

Tech Brief

FHWA-HIF-22-003

https://www.fhwa.dot.gov/pavement/recycling/rap.cfm

Summary Report

WRSC-TR-21-10

https://scholarworks.unr.edu/handle/11714/8000

U.S. Department of Transportation
Federal Highway Administration

EPDs and Buy Clean

How Green Procurement Policies Will Affect the Asphalt Paving Industry

February 15, 2023

Richard Willis
VP of Engineering, Research, and Technology
rwillis@asphaltpavement.org

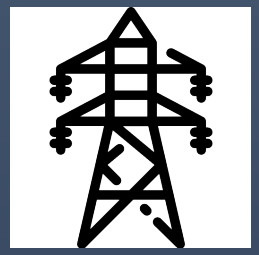
An Industry-Wide Vision

Vision: Sustainable communities and commerce, connected by net zero carbon emission asphalt pavements

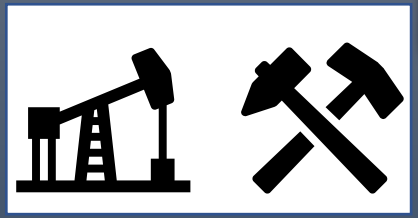
Mission: Engage, educate, and empower the U.S. asphalt community to produce and construct net zero carbon emission asphalt pavements

Production and Construction

Electricity



Net Zero Strategy



Supply Chain

Quality, Durability, Longevity, Efficiency

2022 PARTNERS

KRATON
bp
HOLCIM
SURFACE TECH™
VINCI CONSTRUCTION USA
GALLAGHER ASPHALT
COLAS
ASTEC™
CRH
AJAX The Future is Riding on AJAX.®
EARTHWAVE TECHNOLOGIES
VOLVO
MagnaDATA RealMTRX M.U.C. MUC.SaaS GeoMAH
ingevity
DOW®
KMi KOKOSING MATERIALS, INC.
CPI CONSTRUCTION PARTNERS INC. A LEADING INFRASTRUCTURE COMPANY
TEICHERT
PECKHAM INDUSTRIES, INC.
LINDY PAVING
SUMMIT Materials
Cargill® Helping the world thrive
WIRTGEN GROUP
GRANITE®

2023

HERITAGE CONSTRUCTION + MATERIALS
XBE
Cargill® Helping the world thrive
SURFACE TECH™
WIRTGEN GROUP

Introduction to EPDs

Understanding Carbon

Embodied Carbon

Manufacture, transport and installation of construction materials

Operational Carbon

Building Energy Consumption

https://www.architects.org/news/building-a-low-carbon-future-reducing-embodied-carbon-in-the-built-environment

What is an EPD?

- **Environmental Product Declaration**
  - **Quantified** environmental information on the **life cycle** of a product to enable **comparisons** between products fulfilling the **same function***

- **"Nutrition label" for environmental impacts**
  - ISO Type III Environmental Label

- **Independently verified**

EPD "Nutrition" Label

Your Building Product

Amount per Unit

LCA IMACT MEASURES	TOTAL
Primary Energy (MJ)	12.4
Global Warming Potential (kg CO^2 eq)	0.96
Ozone Depletion (kg CFC- 11 eq)	1.80E-08
Acidification Potential (mol H^+ eq)	0.93
Eutrophication Potential (kg N^- eq)	6.43E-04
Photo-Oxidant Creation Potential (kg O3 eq)	0.121

Your Product's Ingredients: Listed Here

https://westcoastclimateforum.com/cfpt/concrete/strategy1

*Source: ISO 14025:2006. **EPDs from different Product Categories should NOT be compared to each other.**

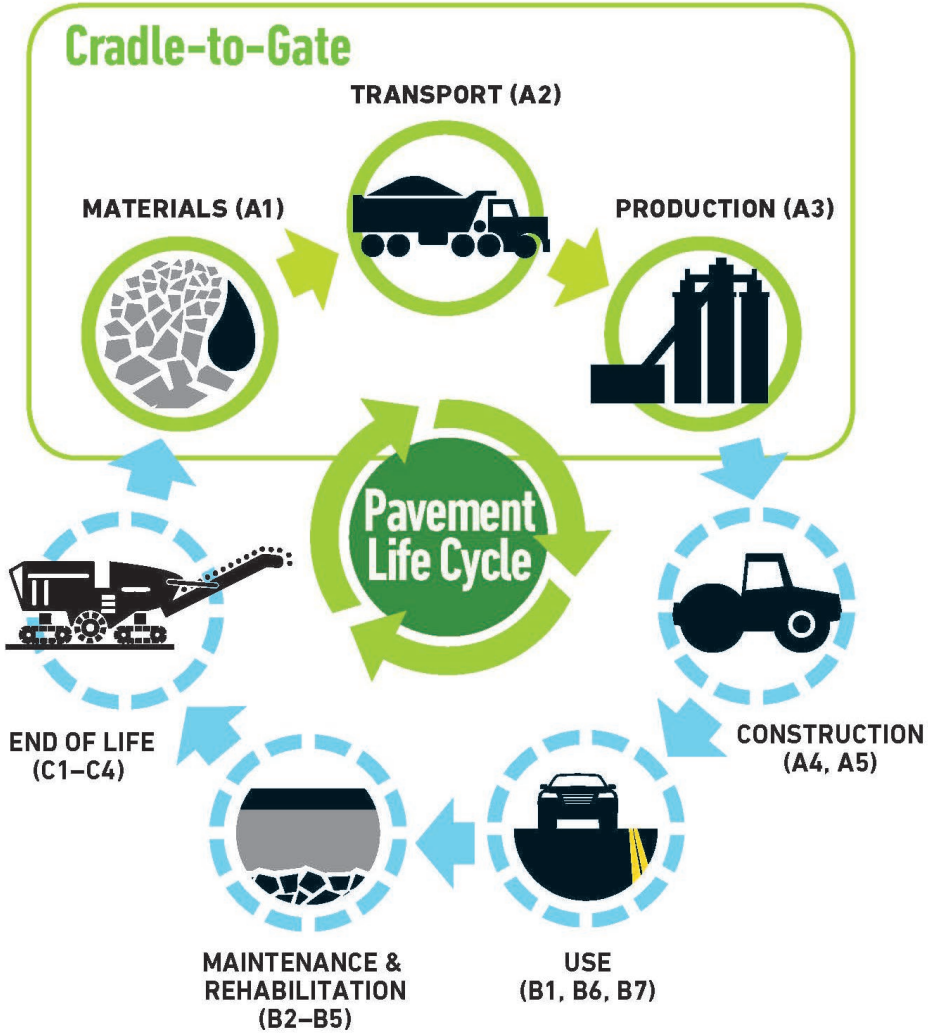
EPDs for asphalt mixtures have a Cradle-to-Gate scope

- **Included:**
  - Materials
  - Transport
  - Production

Emerald ECO LABEL

- **Other life cycle stages are not included**
  - Mix producers have little control over them
  - Can use LCA Pave to look at these stages

LCA PAVE

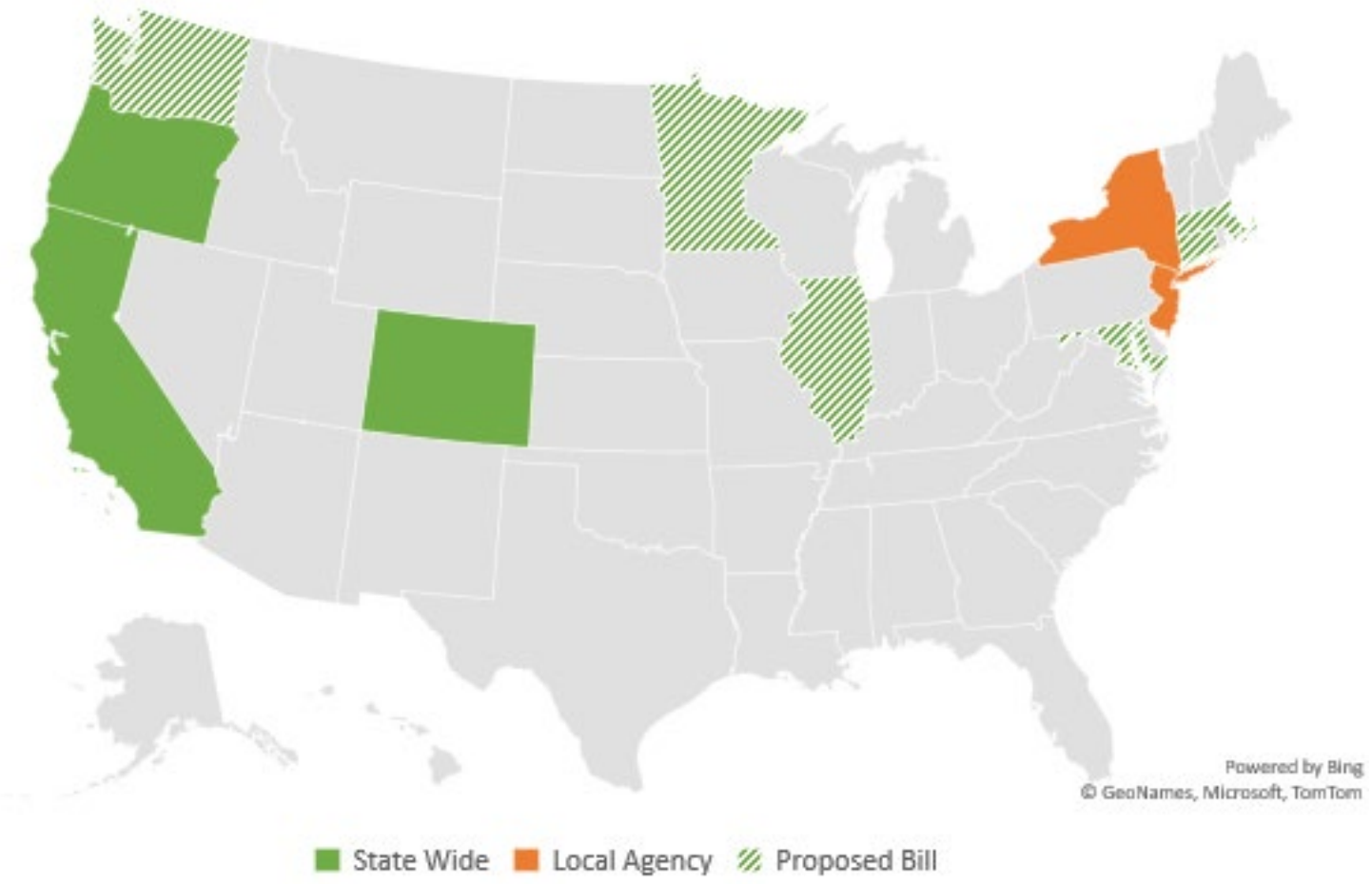


What’s Happening at the Policy Level?

“Buy Clean” Legislation

Jurisdictions with Buy Clean policies that include asphalt mixtures

- Caltrans
- Colorado
- Oregon
- Port Authority of New York and New Jersey
- Illinois, Minnesota, other states are considering policies



Environmentally Preferable Asphalt and Standard

- Federal office buildings, courthouses, and land ports of entry
- Requirements
  - Submit an EPD for each mix
  - Use 2 environmentally preferable techniques
    - At least 21% RAP content
    - Warm mix technology (reduced onsite mix temperature)
    - Non-pavement recycled content (roof shingles, rubber, or plastic)
    - Improved energy/carbon efficiency of plants or equipment (e.g., natural gas)
    - Other environmentally preferable techniques (contractor can propose)

https://www.gsa.gov/real-estate/design-construction/engineering-and-architecture/facilities-standards-p100-overview

The White House Council on Environmental Quality

Buy Clean Task Force

- Coordinating across 17 Federal agencies
  - 90% of federally financed and purchased construction materials
  - Prioritizes steel, concrete, **asphalt**, and flat glass
- U.S. DOT Buy Clean Policy Statement
  - Explore the use of EPDs
  - Develop a Buy Clean Policy based on EPDs
- Partnering with State DOTs to align Buy Clean Policies

Inflation Reduction Act

EPA

- $250 million to standardize EPDs and help industry develop EPDs
- $100 million to develop "low-embodied carbon construction material labeling program"

***** How will low-embodied carbon materials be defined ???**

DOT/FHWA

- $2 billion to procure construction products and materials with "substantially lower" embodied carbon
  - Federal-aid Highways, Federal Lands, etc.
  - Differential Cost or Incentive

Inflation Reduction Act

Interim Determination of Substantially Lower Embodied Carbon

- **Best performing 20%** of similar materials/products
  - If not available locally, then best performing 40%
  - If not available locally, then better than estimated industry average
  - **Agencies will define these thresholds** based on published EPDs
- Also, report **ENERGY STAR** Energy Performance Score (currently under development for asphalt plants)

https://www.epa.gov/inflation-reduction-act/inflation-reduction-act-programs-fight-climate-change-reducing-embodied

U.S. Department of Transportation
Federal Highway Administration

Every Day Counts
Innovation for a Nation on the Move

EDC-7 (2023-2024)

- Integrating GHG Assessment and Reduction Targets in Transportation Planning
- EPDs for Sustainable Project Delivery

Carbon Reduction Program

U.S. Department of Transportation
Federal Highway Administration

President Biden, USDOT Announce New Guidance and $6.4 Billion to Help States Reduce Carbon Emissions Under the Bipartisan Infrastructure Law

Thursday, April 21, 2022

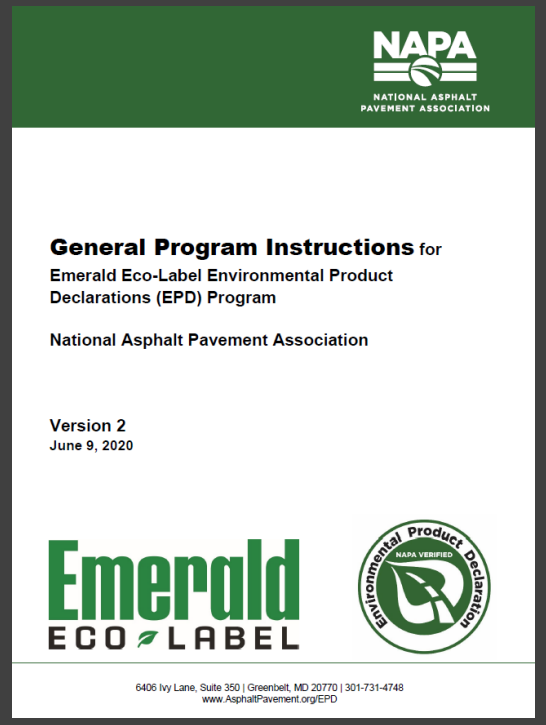
Key program will fund projects that help fight climate change and save Americans money on gas

- Focus is on vehicle fuel consumption/emissions
- FHWA Guidance made “paving activities” eligible
  - Projects must use LCA to quantify carbon emissions reductions
- Enhanced pavement smoothness may also be eligible

Overview of Emerald Eco-Label EPD Tool

Key Components of NAPA's EPD Program

General Program Instructions



NATIONAL ASPHALT PAVEMENT ASSOCIATION

General Program Instructions for
Emerald Eco-Label Environmental Product Declarations (EPD) Program

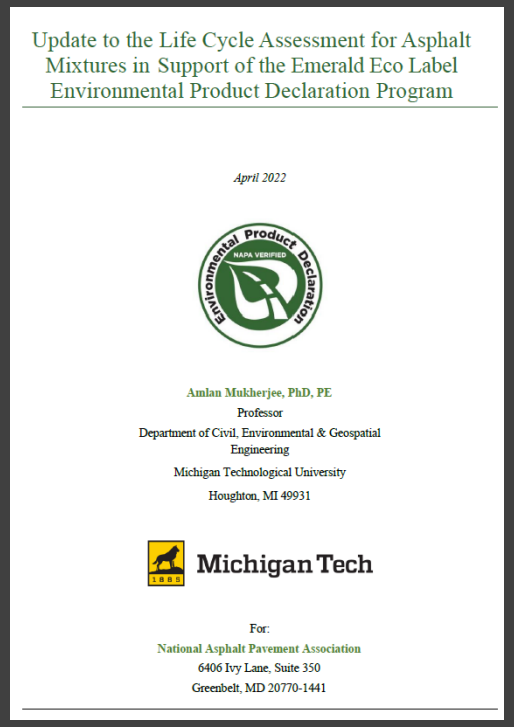
National Asphalt Pavement Association

Version 2
June 9, 2020

Emerald ECO LABEL

6406 Ivy Lane, Suite 350 | Greenbelt, MD 20770 | 301-731-4748
www.AsphaltPavement.org/EPD

Underlying Life Cycle Assessment



Update to the Life Cycle Assessment for Asphalt Mixtures in Support of the Emerald Eco Label Environmental Product Declaration Program

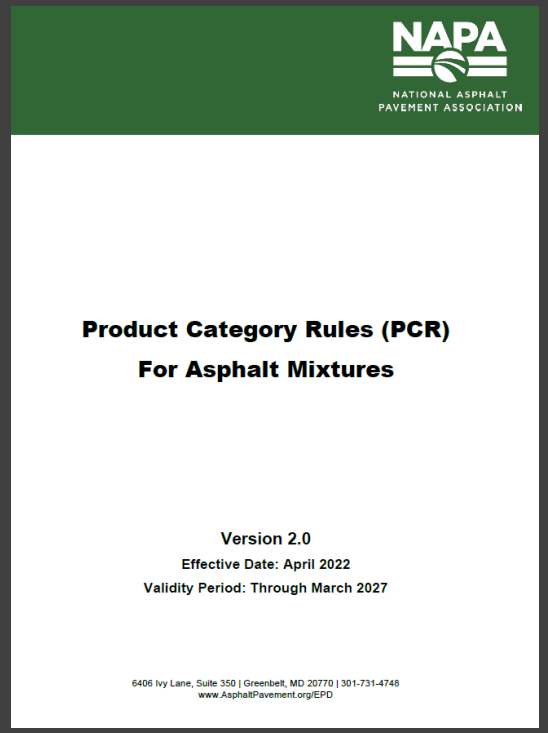
April 2022

Amlan Mukherjee, PhD, PE
Professor
Department of Civil, Environmental & Geospatial Engineering
Michigan Technological University
Houghton, MI 49931

Michigan Tech

For:
National Asphalt Pavement Association
6406 Ivy Lane, Suite 350
Greenbelt, MD 20770-1441

Product Category Rules (PCR)



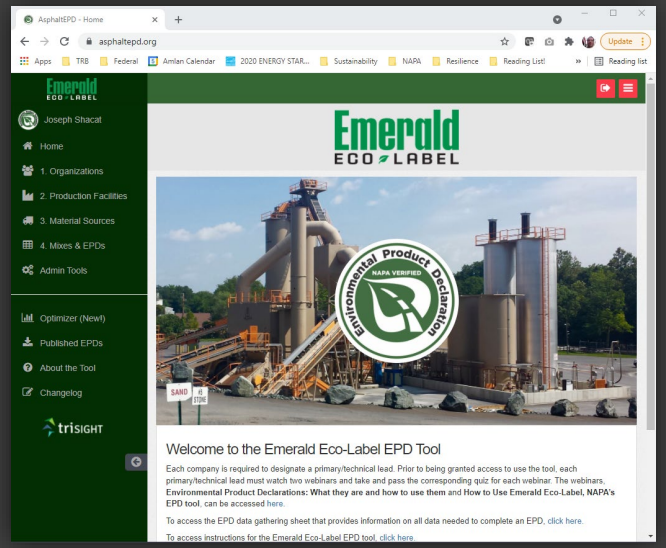
NATIONAL ASPHALT PAVEMENT ASSOCIATION

Product Category Rules (PCR)
For Asphalt Mixtures

Version 2.0
Effective Date: April 2022
Validity Period: Through March 2027

6406 Ivy Lane, Suite 350 | Greenbelt, MD 20770 | 301-731-4748
www.AsphaltPavement.org/EPD

EPD Software



Learn more at www.asphaltpavement.org/epd

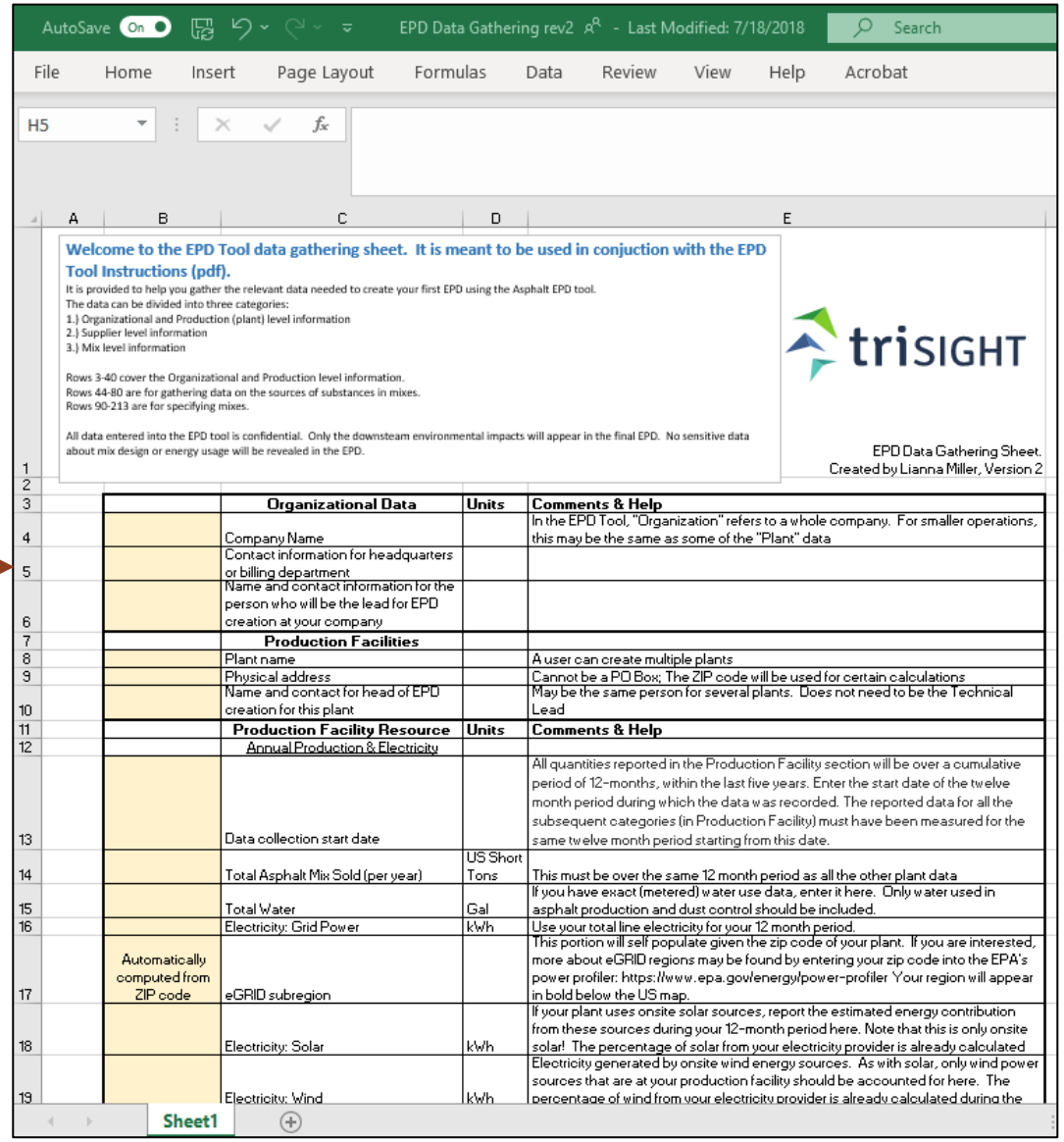
Emerald Eco-Label Software

- NAPA's web-based **software tool**
- Asphalt mix producers use it to develop **verified EPDs**
- EPDs are **plant-specific** & **mix-specific**
- Can be used for **asphalt plants** located in the U.S.
- **Simplified process** that saves mix producers time and money

Independent Verification

How to use Emerald Eco-Label

- **Register** at https://asphaltepd.org/
- **Watch two webinars** and pass the quizzes
- **Compile data** for plant and mixes
  - Use EPD Data Gathering spreadsheet
- **Purchase access** for your plant(s)
- **Enter data** for plant and mixes to produce EPDs
- **Upload supporting documentation**



Data requirements for the plant

- **12 consecutive months of data**
  - Within the past five years
- **Fuel consumption**
  - Burner
  - Hot oil heater
  - Generator
  - Equipment
- **Electricity consumption**
- **Water consumption**
- **Total mix sold (tons)**

Your data is confidential!

Photo courtesy of Duval Asphalt

Data requirements for mix designs

- **Material content (by weight of total mix)**
  - Aggregates
  - Asphalt binder
  - RAP and RAS
  - Additives
- **Transportation mode and distance**
  - Truck, rail, or barge
- **Mix production temperature**

Your data is confidential!

Photo courtesy of Rock Road Companies, Inc.

Upstream datasets

- **The PCR requires the use of public datasets for upstream energy and materials**
  - Fuels and electricity
  - Aggregates
  - Asphalt binder
- **Data gaps are noted in the EPD**
  - Binder additives (polymers, ground tire rubber, etc.)
  - Mix additives (WMA, rejuvenators, fibers, etc.)
- **Cannot develop EPD if data gap >1% (individual material) or 5% (total) of mix by weight**

FEDERAL LCA COMMONS

EPD Optimizer Tool

- Easily **compare** two of your own mixes to each other
- More **granular analysis** of data
- Create **plant variants** to see how changes to plant operations affect EPDs
- Evaluate **economic** and **environmental** impacts of certain changes
  - Switching fuel types
  - Aggregate moisture reduction

Common Questions about EPDs

What is the time and cost of developing EPDs?

Pricing Schedule as of Apr. 1, 2022

Year	Member Rate	Non-member Rate	Years of Tool Access
2022	$3,000 per plant	$6,000 per plant	5
2023	$3,000 per plant	$6,000 per plant	4
2024	$2,750 per plant	$5,500 per plant	3
2025	$2,500 per plant	$5,000 per plant	2
2026	$2,250 per plant	$4,500 per plant	1

- **Initial data collection and plant setup takes most companies a couple of weeks**
- **New mixes typically take 10-15 minutes**

https://www.fhwa.dot.gov/publications/focus/08apr/03.cfm

Does the EPD give credit for Warm Mix?

- **What are the biggest contributors to GHG emissions?**
  - **Burner fuel** consumption
  - **Asphalt binder** content
  - Sometimes, **aggregate hauling** exceeds everything else

Can EPDs be Used for Pavement Type Selection?

- **Not directly – different PCRs**
- **As data inputs to full LCA?**
  - Harmonization issues
  - Lots of uncertainty in use stage modeling
  - Scarce knowledge, experience, and capacity at agencies

Policy Considerations

- **Each agency spec is a different "product"**
- **GWP Limits/Benchmarks/Thresholds**
  - Prequalification?
  - Incentive?
  - A + B + C?
- **Regional variations**
  - Climate
  - Aggregate supply
  - Availability of fuels / grid location
- **Impact of getting better data**
  - GWP may go up or down

Key Takeaways

- EPDs provide verified data to **quantify environmental impacts**
- **Buy Clean** policies are spreading quickly
- **Inflation Reduction Act** will accelerate demand for low carbon materials
- Emission reductions can be achieved with **existing practices and technologies**
- **Prepare your company** by developing EPDs
  - Start with one plant
  - Expand to other plants, benchmark your operations

Thank you!