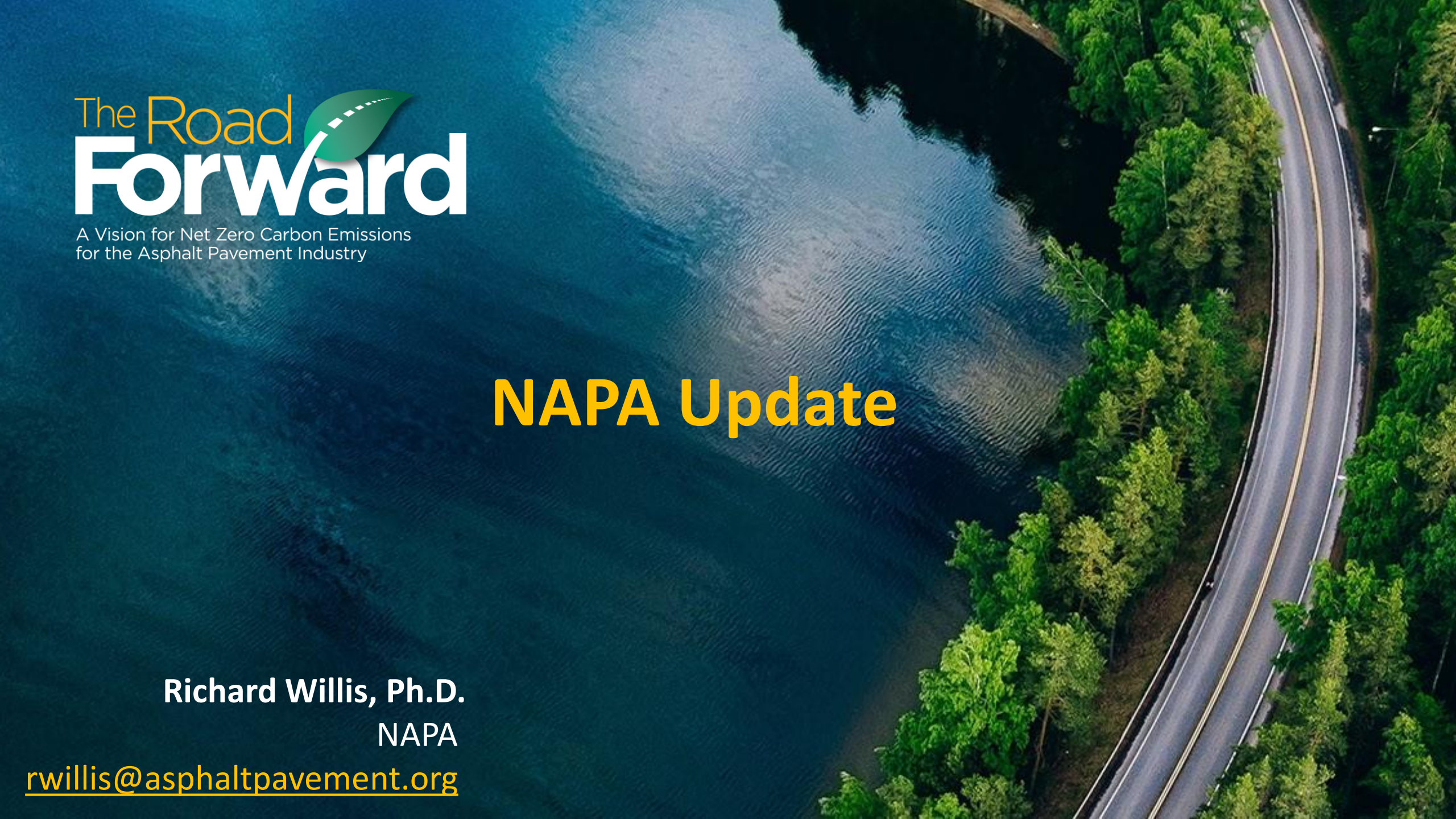


NAPA Update

Richard Willis, Ph.D.
NAPA
rwillis@asphaltpavement.org

Wisconsin

Gold Club (50+ Years)

- D.L. Gasser Construction Inc.
- Payne & Dolan Inc., a Walbec Group Co.
- Scott Construction Inc.
- WEM Automation

30-Plus Club

- Antigo Construction Inc.
- Rock Road Companies, Inc.

State Advisor

Jacob Mrugacz, Rock Road Companies, Inc.

Members

- AC Business Media
- American Asphalt of Wisconsin, Inc.
- Benchmark Inc.
- Enerquip Thermal Solutions
- Flores Automation & Machine Control
- H. G. Meigs LLC
- Iverson Construction
- Mathy Construction Co.
- Monarch Paving Co.
- Motion Engineering, Inc.
- MTE
- Northeast Asphalt, a Walbec Group Co.
- Northwoods Paving
- Parisi Construction Co., Inc. a Walbec Co.
- Paving Marketers
- River City Paving
- Road Widener LLC
- RMS International
- Wolf Paving Co. Inc.

An Industry-Wide Vision

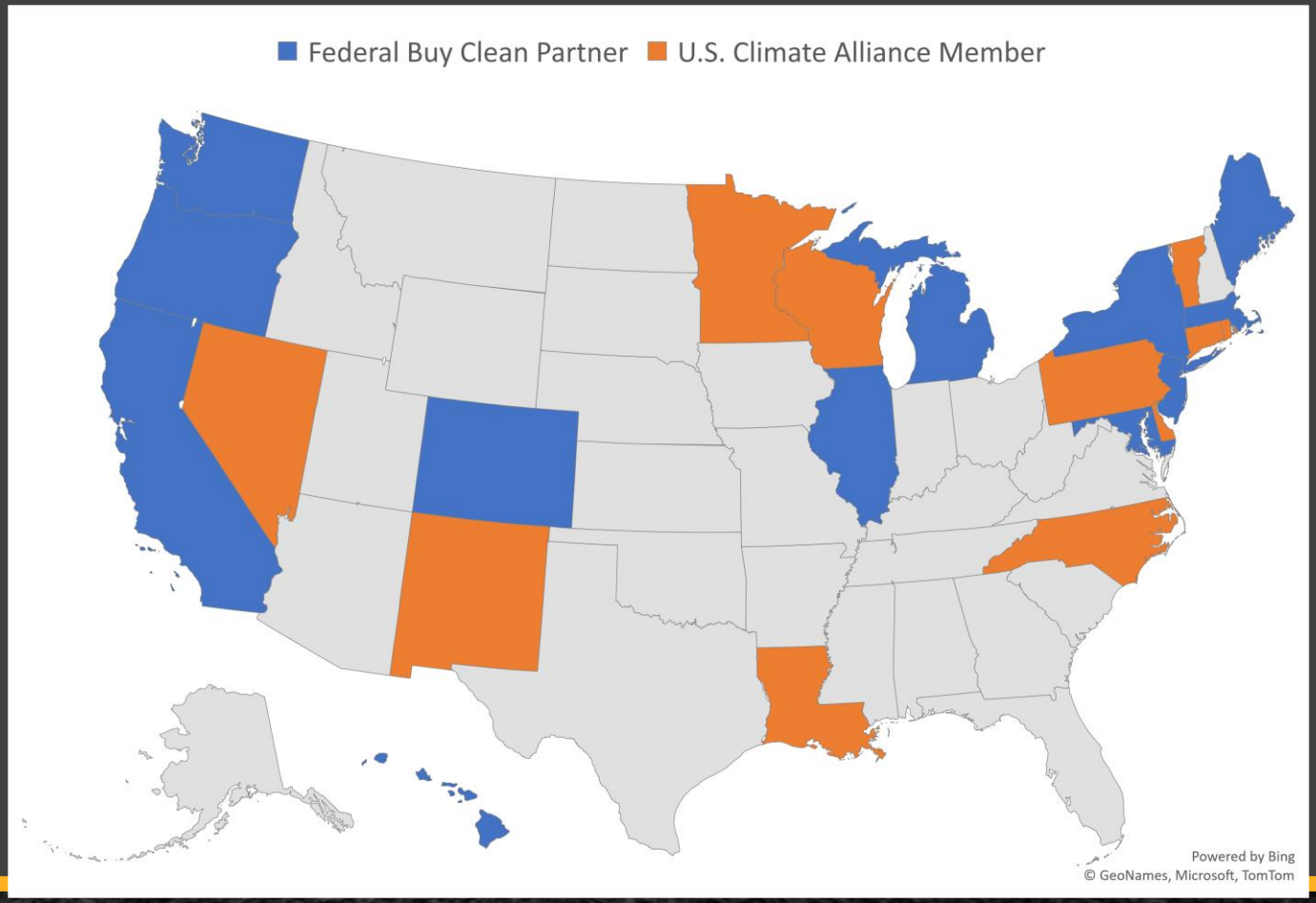
THE ROAD FORWARD PARTNERS

Colorbiotics®
LINDY PAVING
COLAS
HOLCIM
VOLVO
HERITAGE CONSTRUCTION + MATERIALS
ingevity
TEICHERT
ASTEC™
Cargill® Helping the world thrive
GRANITE
CRH
EARTHWAVE TECHNOLOGIES
AJAX The Future is Riding on AJAX.®
WIRTGEN GROUP
bp
MAGNADATA RealMTRX MUC GeoMAH MUCSaaS
XBE
certainteed SAINT-GOBAIN
ARKEMA
SAPPHIRE GAS SOLUTIONS
CPI CONSTRUCTION PARTNERS INC. A LEADING INFRASTRUCTURE COMPANY
DOW®
SURFACE TECH™
KRATON
GALLAGHER ASPHALT
PECKHAM INDUSTRIES, INC.
KMI KOKOSING MATERIALS, INC.
VINCI CONSTRUCTION USA
GEORGE REED INC. GENERAL ENGINEERING CONTRACTORS SINCE 1944
SUMMIT Materials

The White House Council on Environmental Quality

Federal Buy Clean Partnership

- 12 States
  - Support procurement of low-carbon materials for state funded projects
- U.S. Climate Alliance
  - 10 additional states
  - Committed to significant GHG reductions in accordance with the Paris Agreement



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

FEMA

- Agencies can require low carbon materials
- FEMA funds will pay the differential cost or incentive

https://www.fema.gov/sites/default/files/documents/fema_inflation-reduction-act-implementation-memo_032023.pdf

https://www.statecollege.com/articles/local-news/fema-awards-additional-funding-for-purdue-mountain-road-repair/

Inflation Reduction Act

EPA 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
  - **GSA and FHWA 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

Carbon Reduction Program (IIJA/BIL)

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

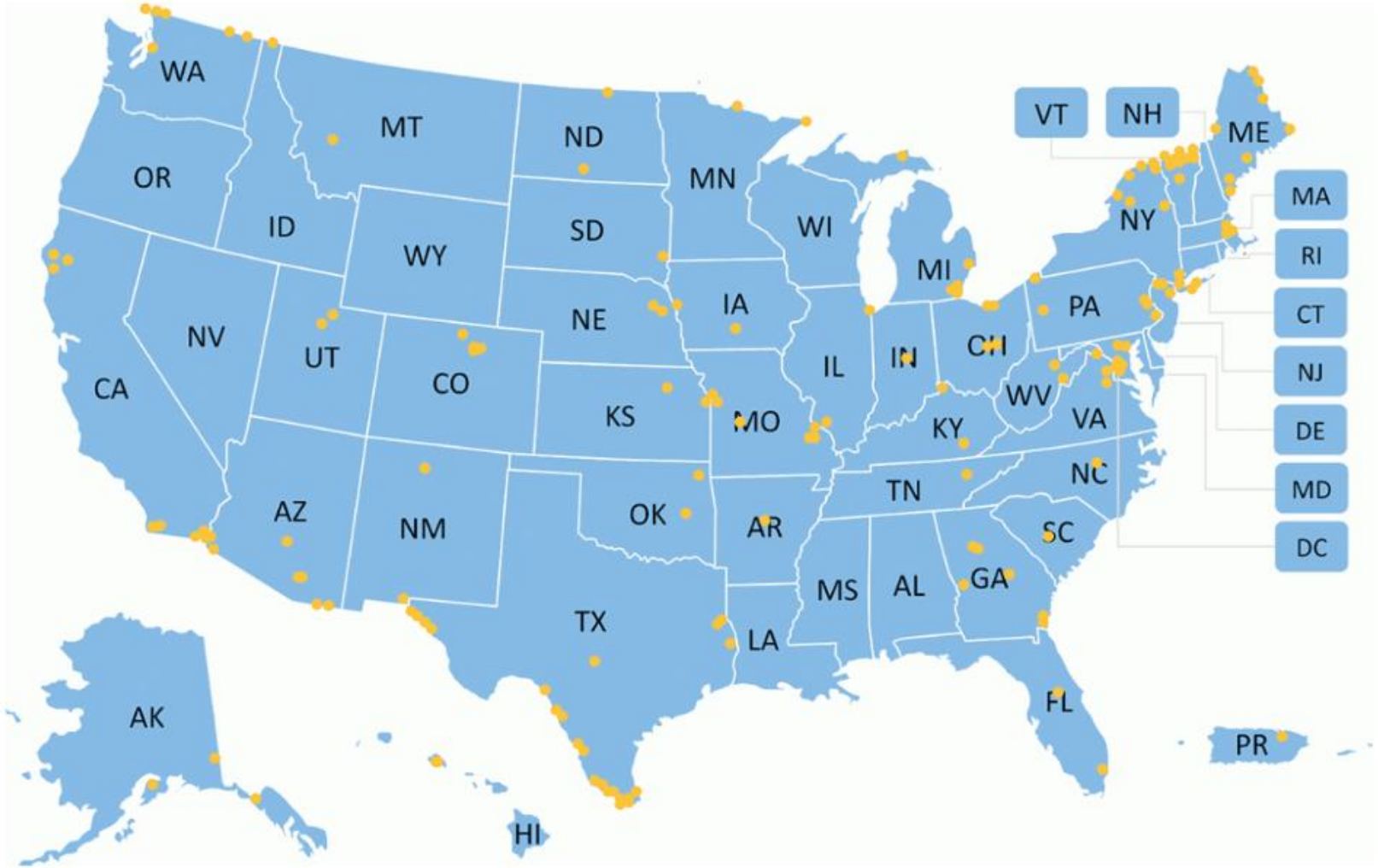
Pilot Low Carbon Material Standard

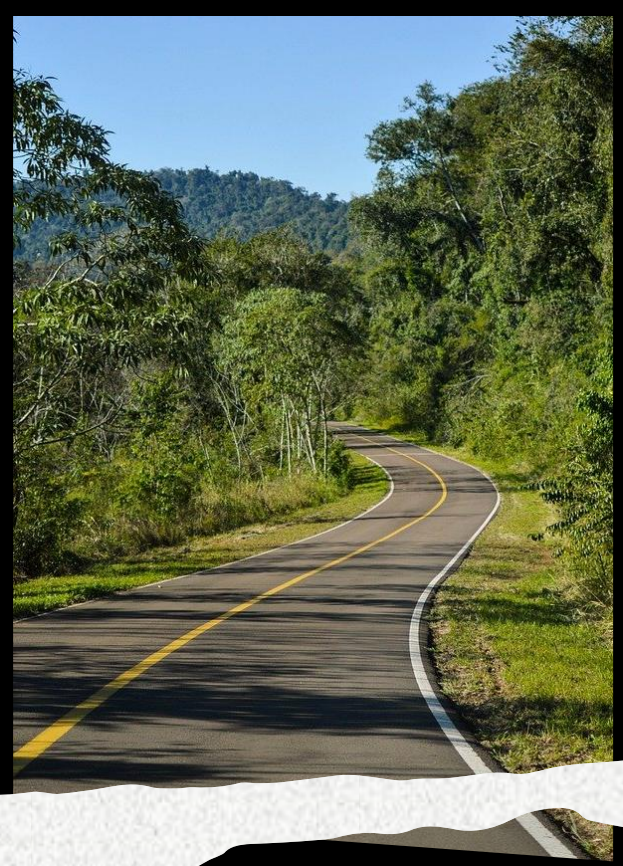
- Pilot Projects in CO, AZ, ND, and TX

GSA IRA Limits for Low Embodied Carbon Asphalt - May 16, 2023 (EPD-Reported GWPs, in kilograms of carbon dioxide equivalent per metric ton - $kgCO_2e/t$)		
Top 20% Limit	**Top 40% Limit**	**Better Than Average Limit**
55.4	**64.8**	**72.6**

- Same limits apply to all mix types

Low-embodied carbon projects



Industry Goals

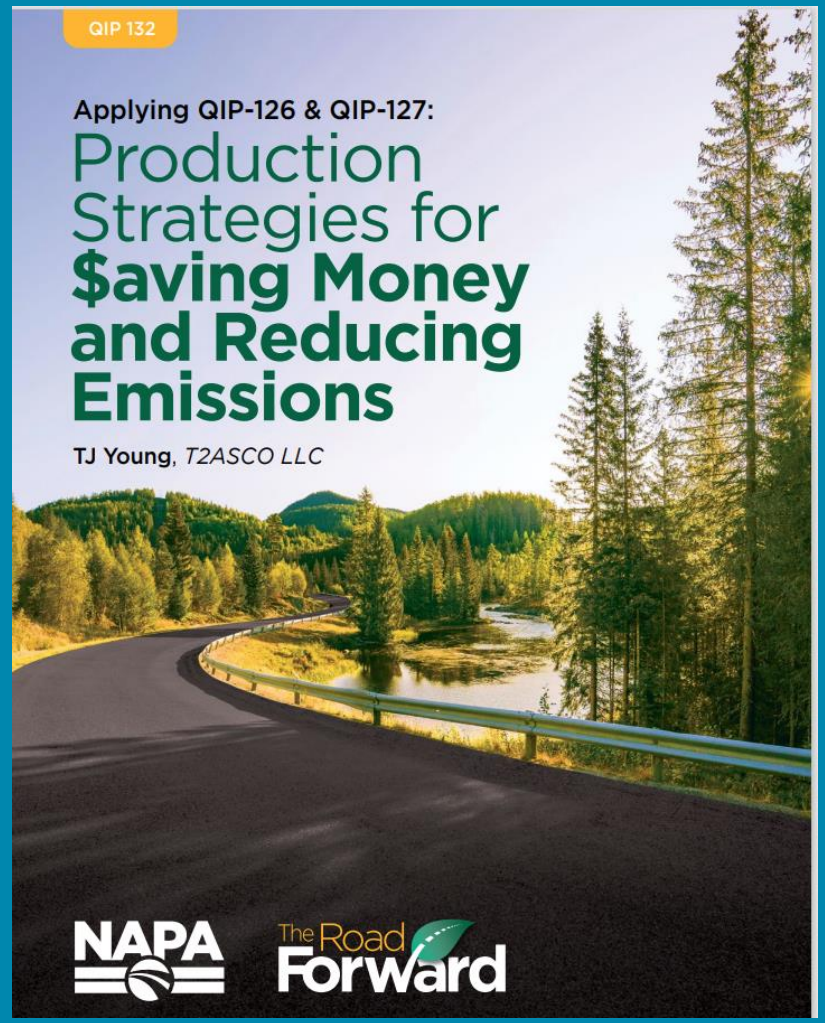
Net Zero Production and Construction

- Operational control
- Warm Mix Asphalt

Industry Goal 1	Scope 1 Emissions
Achieve net zero carbon emissions during asphalt production and construction by 2050.	

Net Zero Production and Construction

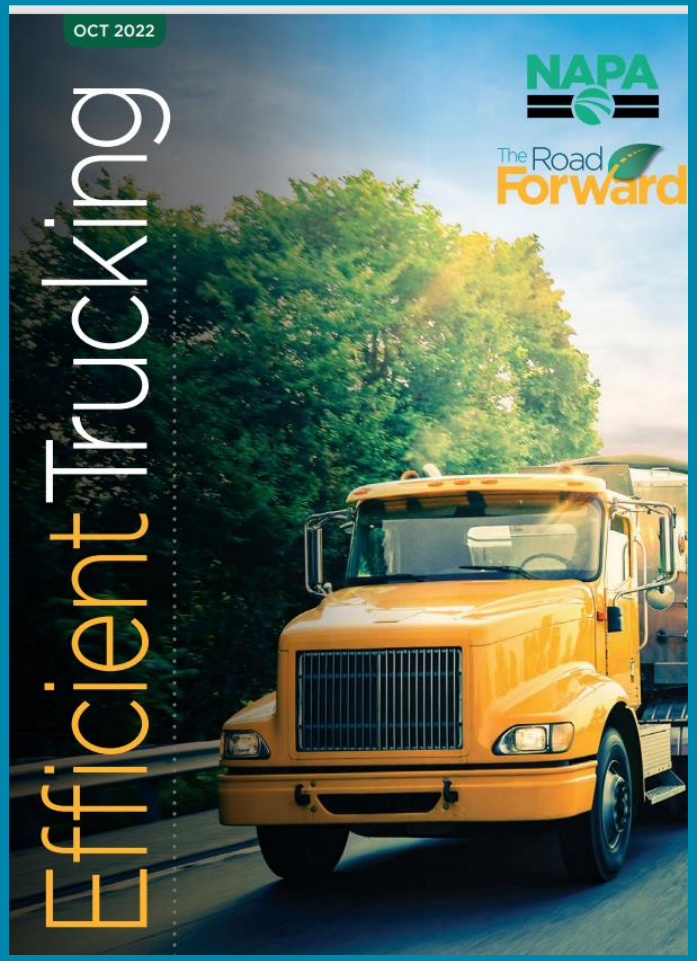
- Hot oil heater & insulation efficiency
- Drying efficiency
- Stockpile moisture
- Target drying fuel consumption expectations



Net Zero Production and Construction

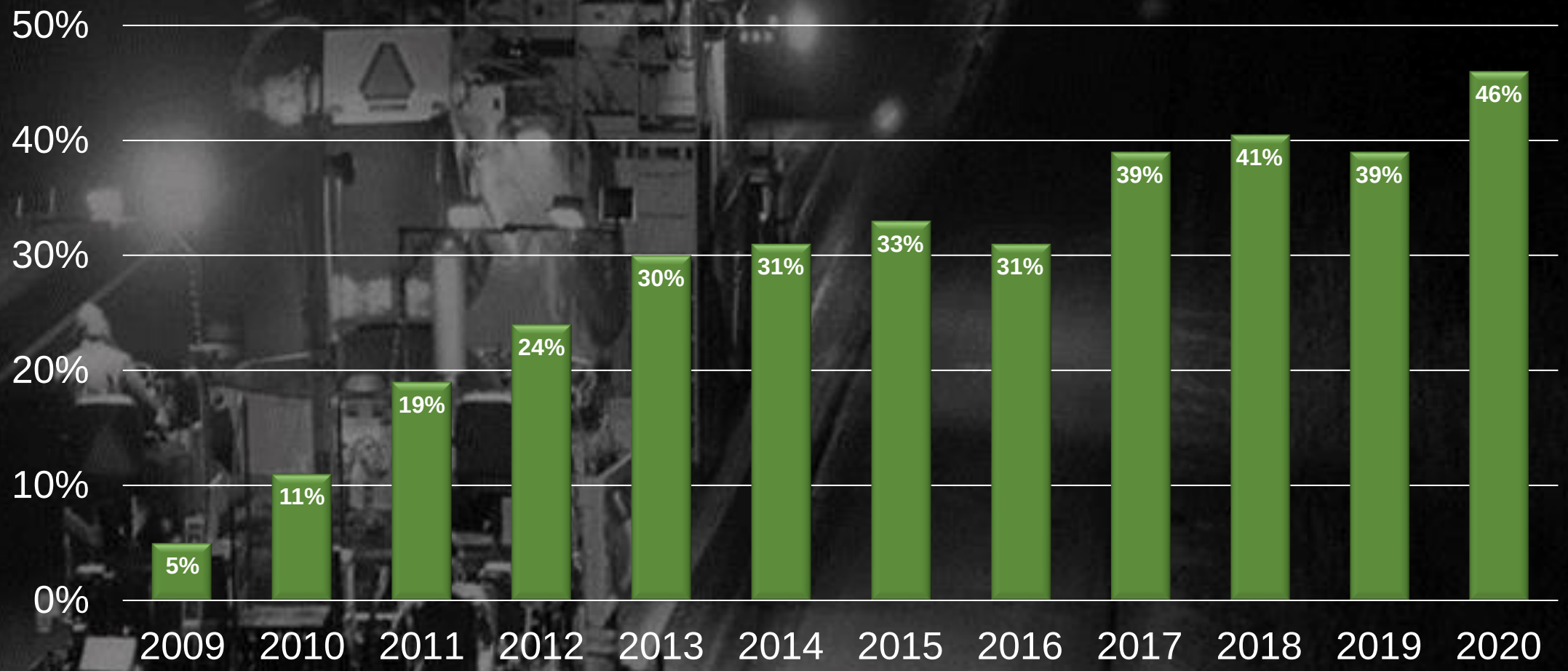
- Planning
- Scheduling
- Management/Execution

- Includes a tactical checklist



Warm Mix Asphalt (WMA) Technologies

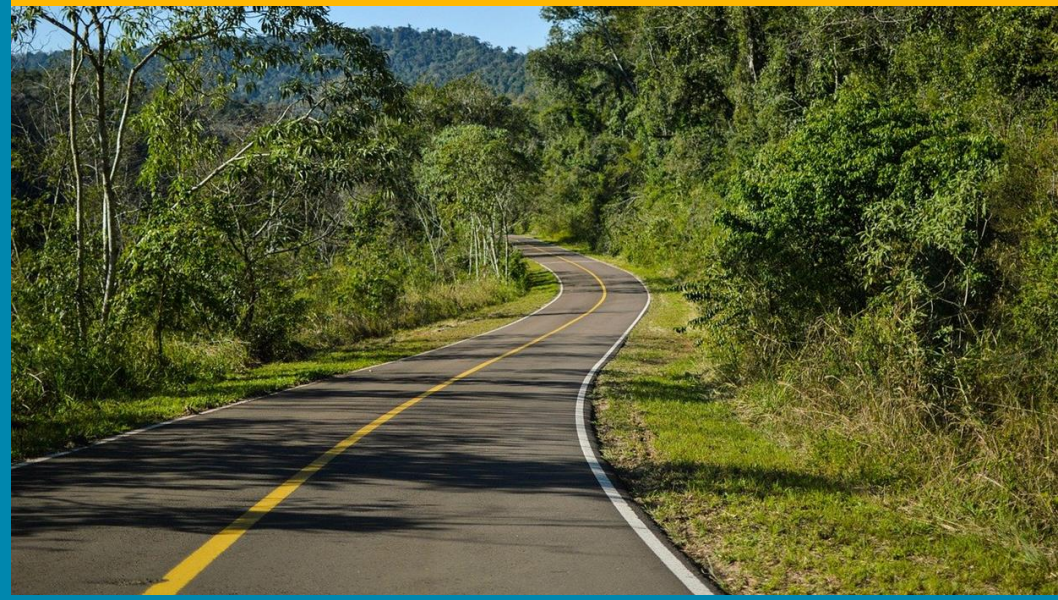
Percentage of Total Asphalt Production in the U.S.



Pavement Quality, Durability, and Use

- Alternative construction scheduling
- Perpetual pavements
- Rolling resistance
- Contract incentives for improved quality and improved vehicle fuel economy

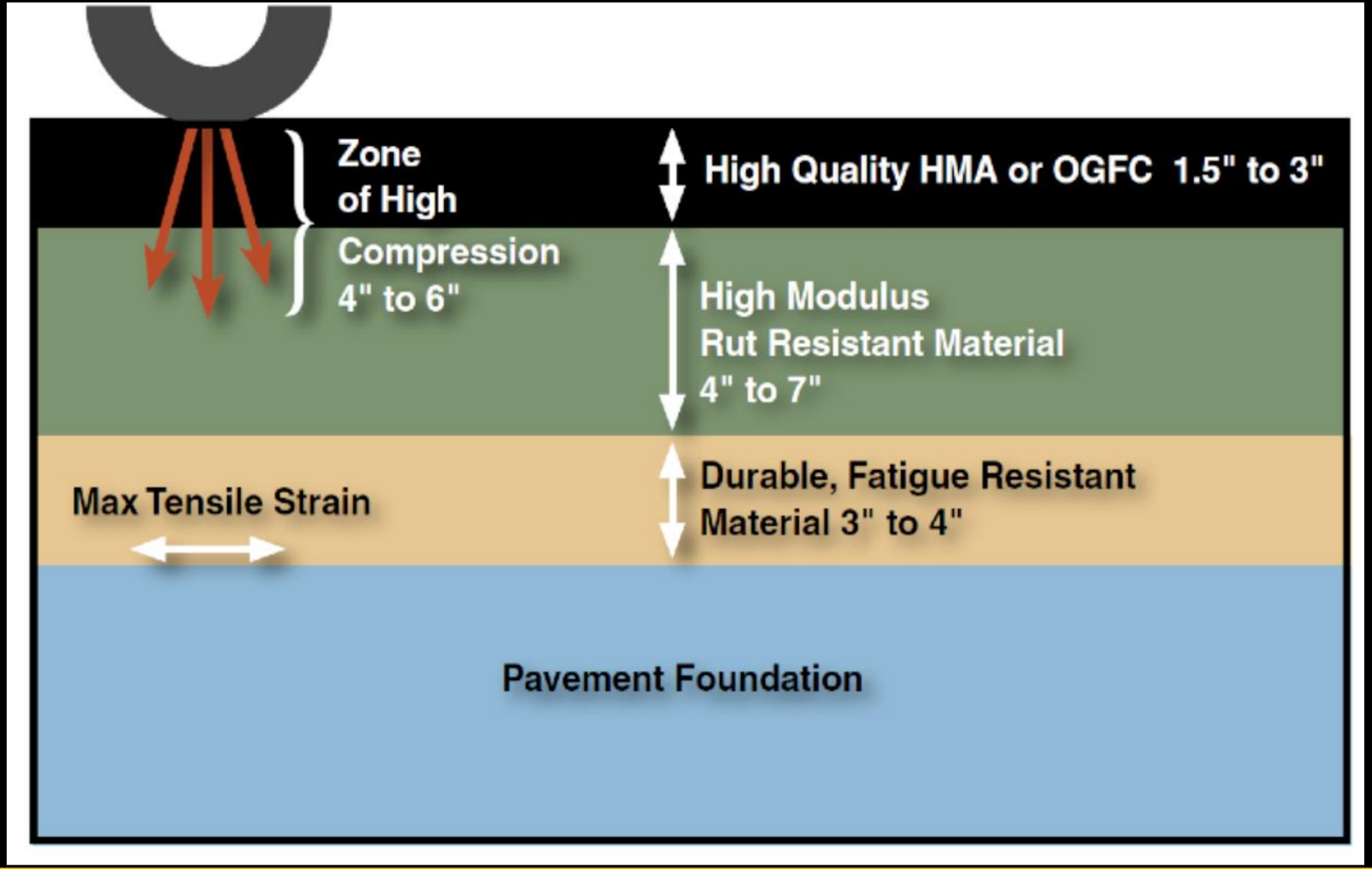
Industry Goal 2	Downstream Scope 3 Emissions
Partner with customers to reduce emissions through pavement quality, durability, longevity, and efficiency standards by 2050	



I suppose it is tempting, if the only tool you have is a hammer, to treat everything as if it were a nail.

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Abraham Maslow



NATIONAL ASPHALT PAVEMENT ASSOCIATION

Perpetual Pavement Structure

NATIONAL ASPHALT PAVEMENT ASSOCIATION

October 28-30, 2024
Louisville

Net Zero Materials Supply Chain

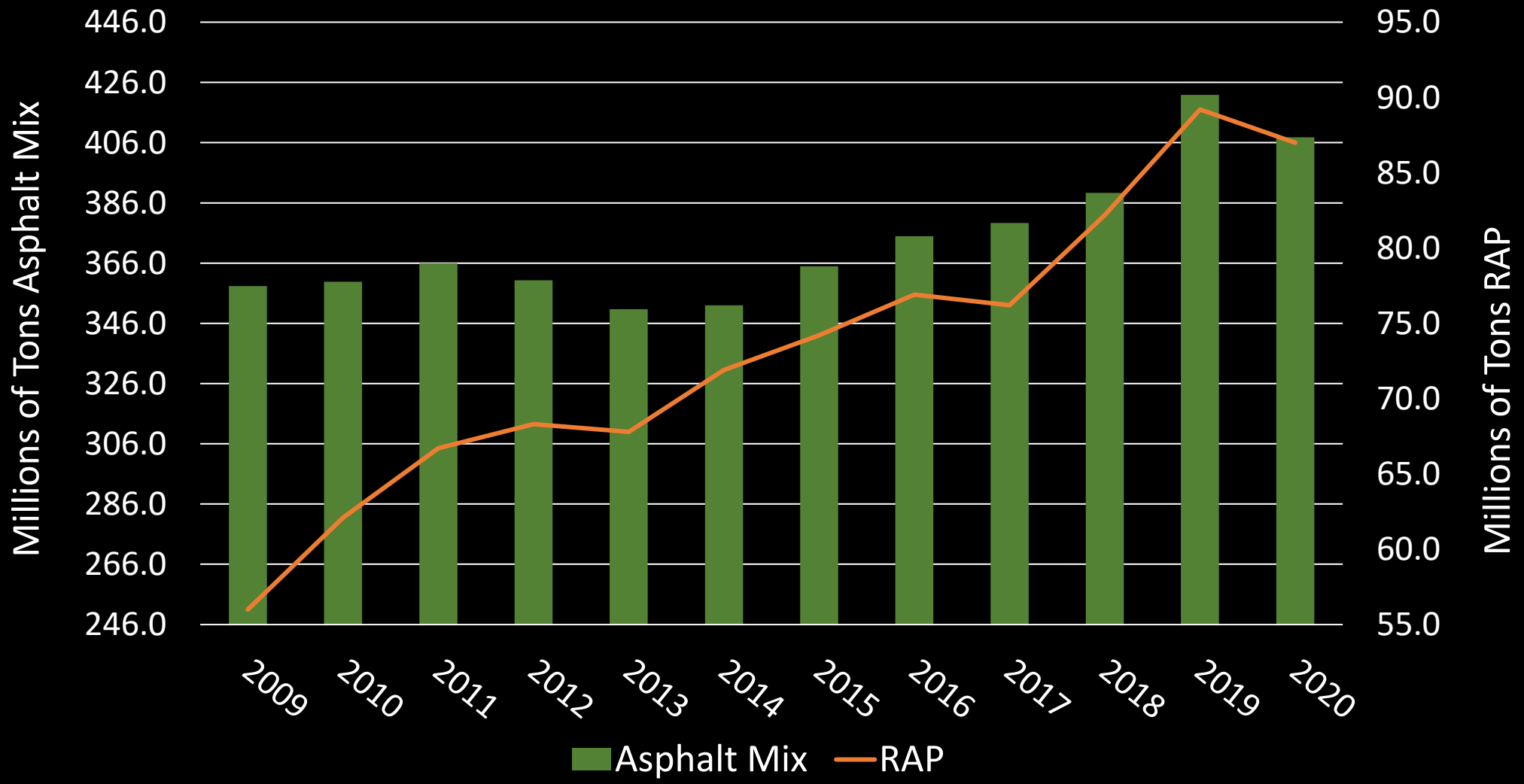
- More recycled material
- Balanced Mix Design
- New technology and materials

Industry Goal 3	Upstream Scope 3 Emissions
Develop a net zero materials supply chain by 2050	

"We are America's No. 1 most recycled product,"
NAPA's Jay Hansen told *The New York Times*.

Asphalt Mix and RAP Tonnage

Total Production and Use in the U.S.



NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION

PRIORITIZING RAP
SAVES ROAD OWNERS MONEY, REDUCES EMISSIONS, AND IMPROVES PERFORMANCE

How to capture the highest value from infrastructure investments

Introduction
Reclaimed asphalt pavement (RAP) is a valuable material sourced from processes like milling or the removal of asphalt pavements. By detailing the economic, environmental, and performance advantages of RAP, this paper illustrates both the importance of giving priority to RAP utilization in new asphalt mixture production and why using RAP in aggregate replacement and shoulder construction provides a lower return on investment to the road owner.

Cost-Efficiency through Aggregate and Asphalt Binder Replacement
The incorporation of RAP in asphalt mixture production yields substantial cost savings. The aggregate and asphalt binder within RAP can efficiently replace virgin materials, resulting in reduced financial and environmental burdens associated with acquiring these natural resources.

Compared side by side, the savings achieved using one ton of RAP in a common asphalt surface mixture against the use of RAP as shoulder gravel are overwhelming.

Table 1: Costs of Virgin Materials (NAPA)

Material		% of Market	Cost/Ton 2021
Asphalt Binder	Unmodified	90	$490.65
	Modified	10	$614.01
	Weighted Average*		$519.45
Aggregate	Crushed Stone	90	$11.79
	Sand and Gravel	10	$8.98
	Weighted Average		$11.51

**The asphalt binder weighted average calculation takes into account that 37 states provide unmodified binder index pricing, while only 5 states provide both modified and unmodified binder pricing.*

The comparisons demonstrate how impactful capturing the asphalt binder replacement value of RAP is when utilized in the production of asphalt mix. As shown in Table 2, road owners save three times more by using RAP in a mix (valued at a cost equivalent to replacing *both* virgin aggregate and virgin asphalt binder in a new asphalt mixture) compared to using it as aggregate alone.

Table 2: Cost Savings of One Ton of RAP, Based on Use (Williams et al, 2023)

Material	% Agg.	% AC	Aggregate Cost Savings, $/Ton	Asphalt Binder Cost Savings, $/Ton	Total Cost Savings, $/Ton
RAP in Asphalt Mix	95	5	$10.93	$25.97	$36.90
RAP in Aggregate	100	0	$11.79	$0	$11.79

Sustainable Resource Management and Environmental Advantages
Utilizing RAP in new asphalt mixture production plays a unique role in conserving precious natural resources. By reducing the demand for new aggregates and virgin asphalt binders, using RAP significantly extends the lifespan of valuable resources, aligning with sustainability practices and policies, as well as global initiatives that champion environmentally responsible construction methods.

Integrating RAP into asphalt mixtures yields substantial environmental advantages. RAP use can conservatively lead to a 15% reduction in upstream energy requirements for asphalt production, accompanied by a notable 10-20% decrease in greenhouse gas emissions. These reductions are attributed to the decreased need for producing raw materials (aggregates and asphalt binder), as well as reduced raw material transportation to the asphalt plant.

Simple Mix from a Typical Plant

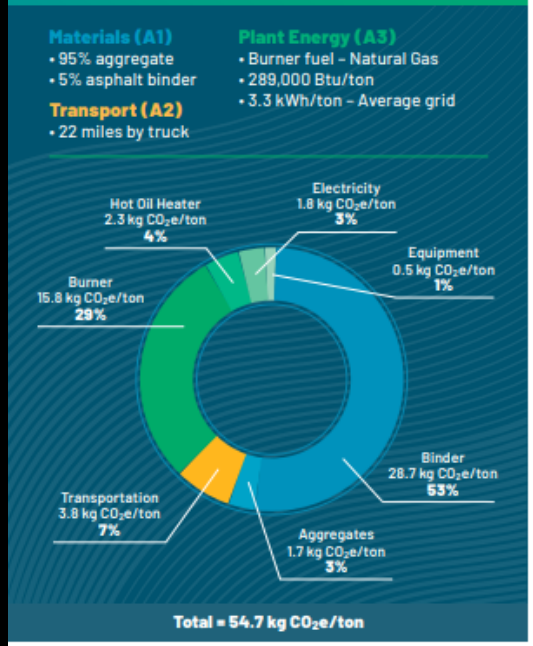


Figure 1: Levers to Reduce Emissions at a Typical Mix Plant (NAPA)

Figure 1 demonstrates that processing the asphalt binder component accounts for 53% of emissions, though it represents just 5% of the mix. Meanwhile, the emissions associated with the aggregate account for just 3% of emissions, while representing 95% of the mix. By using RAP as a substitute for asphalt binder and aggregate (saving 28.7 kg emissions), as opposed to only aggregate (saving just 1.7 kg emissions), road owners save 16 times more upstream emissions associated with virgin material procurement.

Enhanced Pavement Performance
Incorporating RAP into asphalt mixtures does not lead to a degradation in quality. With an engineered mix design and stringent RAP quality control, the performance of asphalt mixtures can be elevated through RAP incorporation in new asphalt mixes. When executed correctly, asphalt mixtures with RAP can match or even surpass the performance of asphalt mixes composed solely of virgin materials (West et al, 2011), resulting in longer-lasting pavements, minimizing maintenance needs and repairs, and generating long-term cost efficiencies.

Conclusion
Given the substantial cost savings, sustainable resource management, environmental gains, and performance enhancements, road owners would be wise to prioritize use of RAP in new asphalt mixture production. Rigorous quality assurance and adept mix design practices are pivotal in maximizing these advantages. By prioritizing the use of RAP, the asphalt pavement industry can reduce costs for road owners and reduce emissions for communities, while enhancing pavement performance for roadway users—enabling road owners to improve the sustainability of their asphalt pavements.

The Road Forward

West, R., et al. Use of Data from Specific Pavement Studies Experiment 5 in the Long-Term Pavement Performance Program to Compare Virgin and Recycled Asphalt Pavements. Transportation Research Record: Journal of the Transportation Research Board, January 2011.

Williams, B.A., J.R. Willis, & J. Shacat. (2022). *Annual Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2021, 12th Annual Survey* (IS 138). National Asphalt Pavement Association, Greenbelt, Maryland. DOI:10.13140/RG.2.2.23149.26081

BMD Approaches

A. Volumetric Design with Performance Verification
   - Volumetric mix design + performance testing at OBC

B. Volumetric Design with Performance Optimization
   - Volumetric mix design + performance testing to adjust OBC

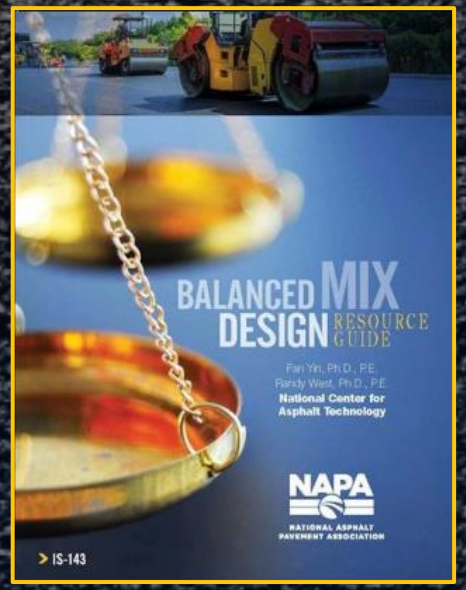
C. Performance-Modified Volumetric Design
   - Performance testing to optimize mix components and proportions + volumetric verification

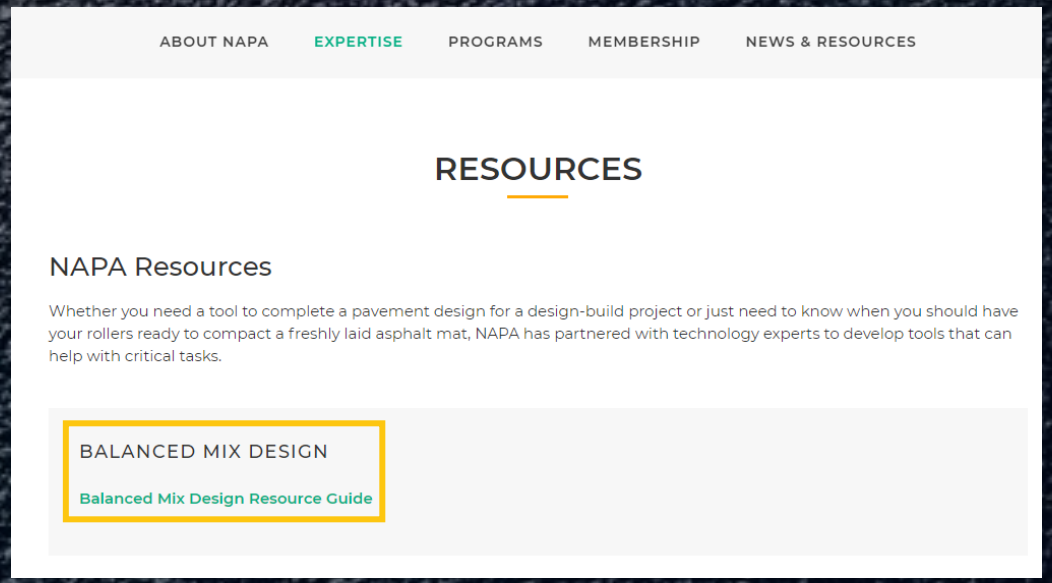
D. Performance Design
   - Performance testing to optimize mix components and proportions

BMD Approaches

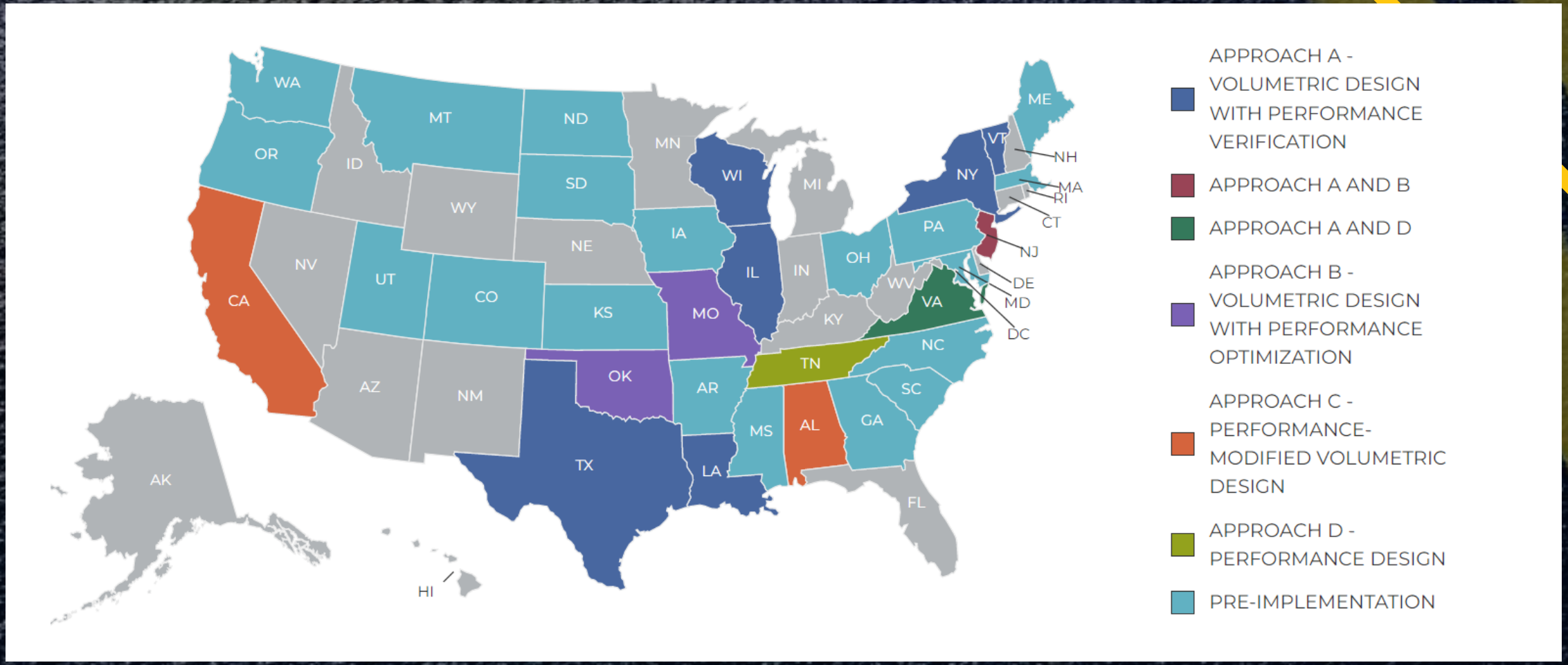
Approach A → B → C → D

- Degree of strictness on meeting volumetric criteria ⬇
- Potential for innovation in meeting performance criteria ⬆





BMD Approaches



Challenges in Design & Production

- **Educate owners and producers on the use and acceptance of BMD**


BALANCED MIXTURE DESIGN:
AGENCY BUSINESS CASE

WHAT IS BALANCED MIXTURE DESIGN?

BUSINESS OPPORTUNITIES

BMD Agency Business Case

BMD Industry Business Case

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

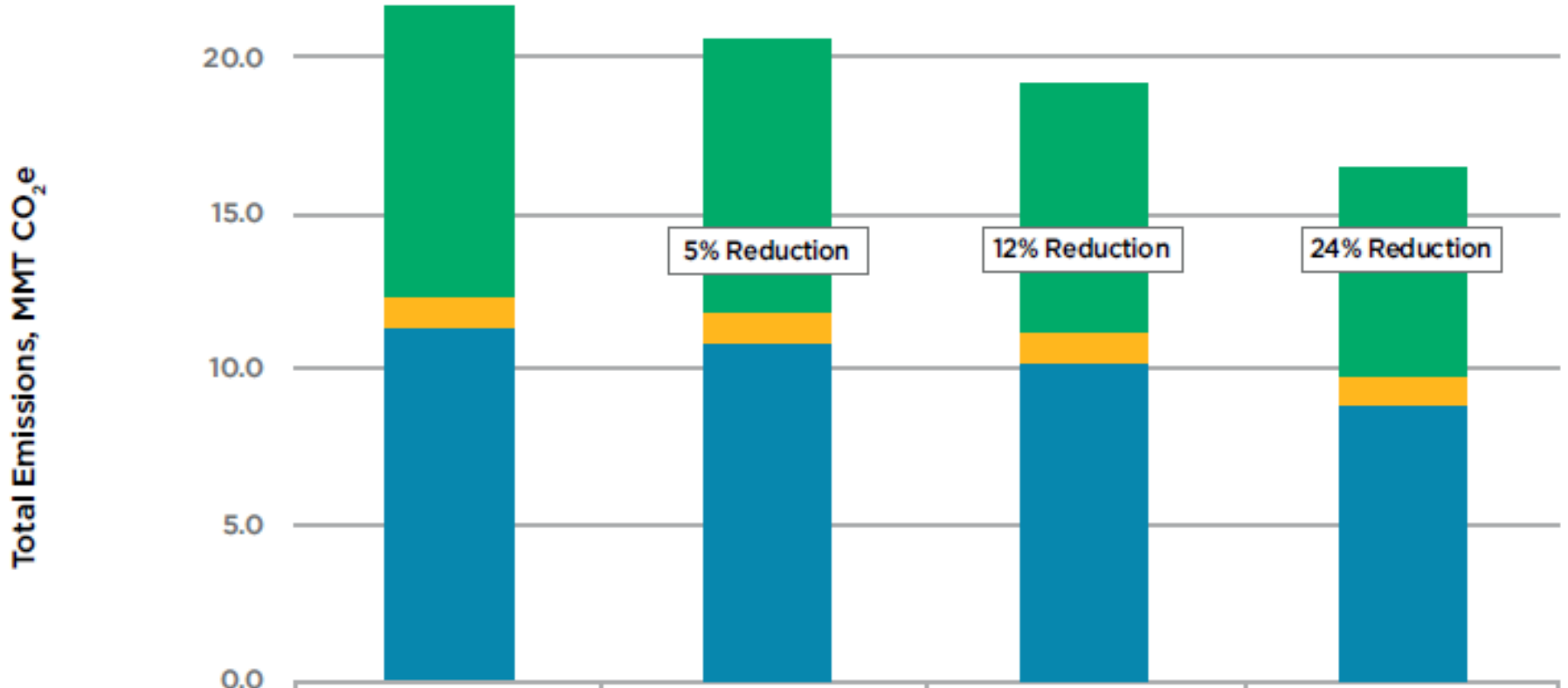
BMD Implementation Working Group

- Coming soon!
- Evaluate research, standards, and frameworks to help owners make informed decisions related to BMD implementation.
- NAPA will lead the effort.
- FHWA to support state agency and academic travel.
- Applications open soon!

Emissions Reduction Scenarios

Parameter	2019 Baseline	Short-Term	Intermediate	Long-Term
RAP Content	21%	25%	30%	40%
Natural Gas Consumption as Percentage of Fuel Combusted	69%	72%	75%	90%
Aggregate Moisture Content Reduction	N/A	0.25%	0.50%	1.0%
Asphalt Mix Production Temperature Reduction	N/A	10 °F	25 °F	40 °F
Reduction in Electricity Consumption Intensity	3.32 kWh/ton	5%	10%	20%

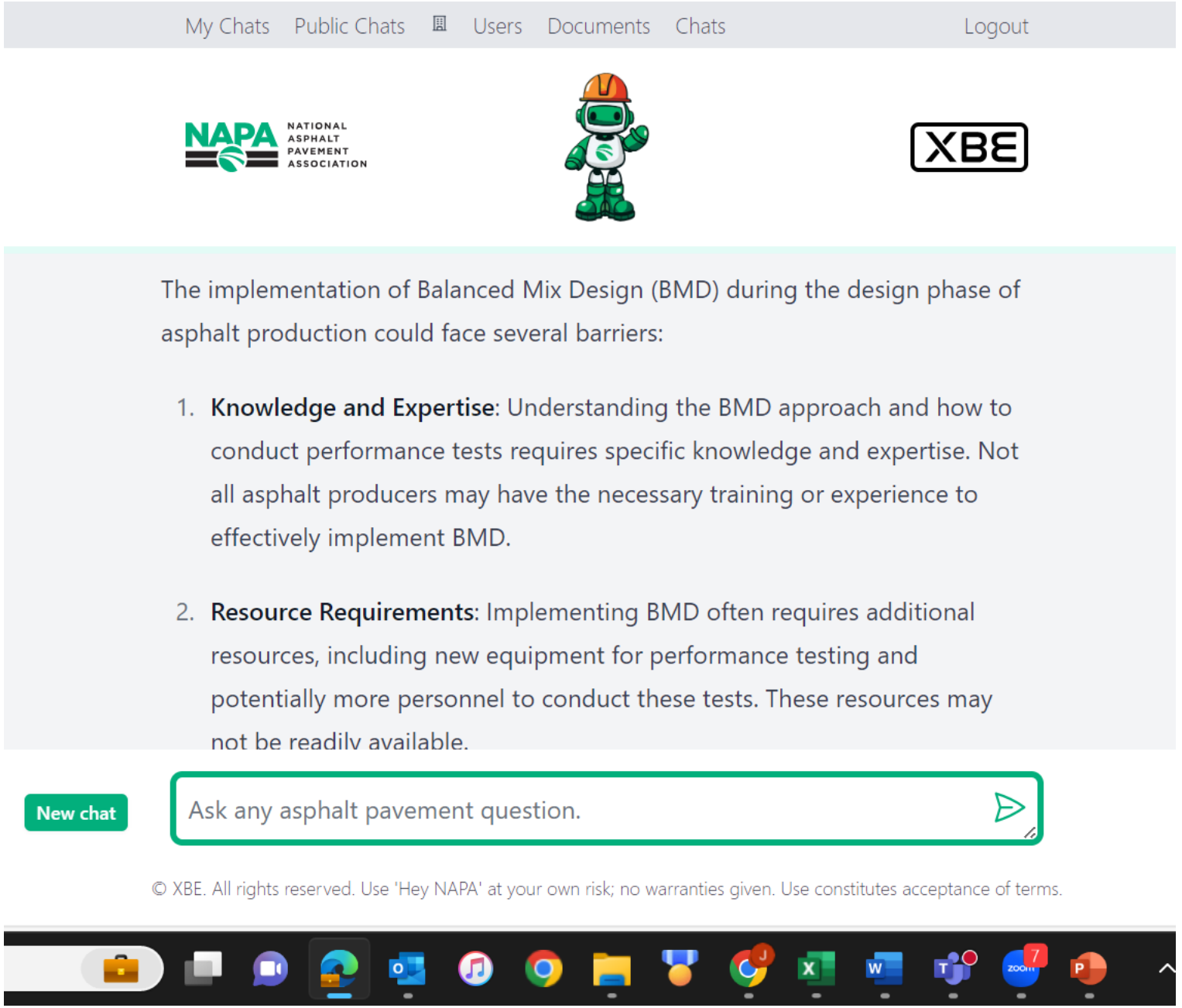
Results - Emissions Reduction Scenarios



	2019 Baseline	Short	Intermediate	Long-Term
Total (A1-A3)	21.7	20.6	19.1	16.5
Mix Production (A3)	9.4	8.8	8.0	6.8
Transportation (A2)	1.0	1.0	1.0	0.9
Raw Materials (A1)	11.3	10.8	10.1	8.8

Hey NAPA!

What are some of the current barriers for contractors implementing BMD?



What's it going to take to…

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