

Update and Insights from the Asphalt Institute

Mark Buncher, Ph.D., P.E.
Vice President of Engineering



**BLACK TO BASICS
SPRING TRAINING**



Update and Insights from the Asphalt Institute (the original AI)

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SPRING TRAINING

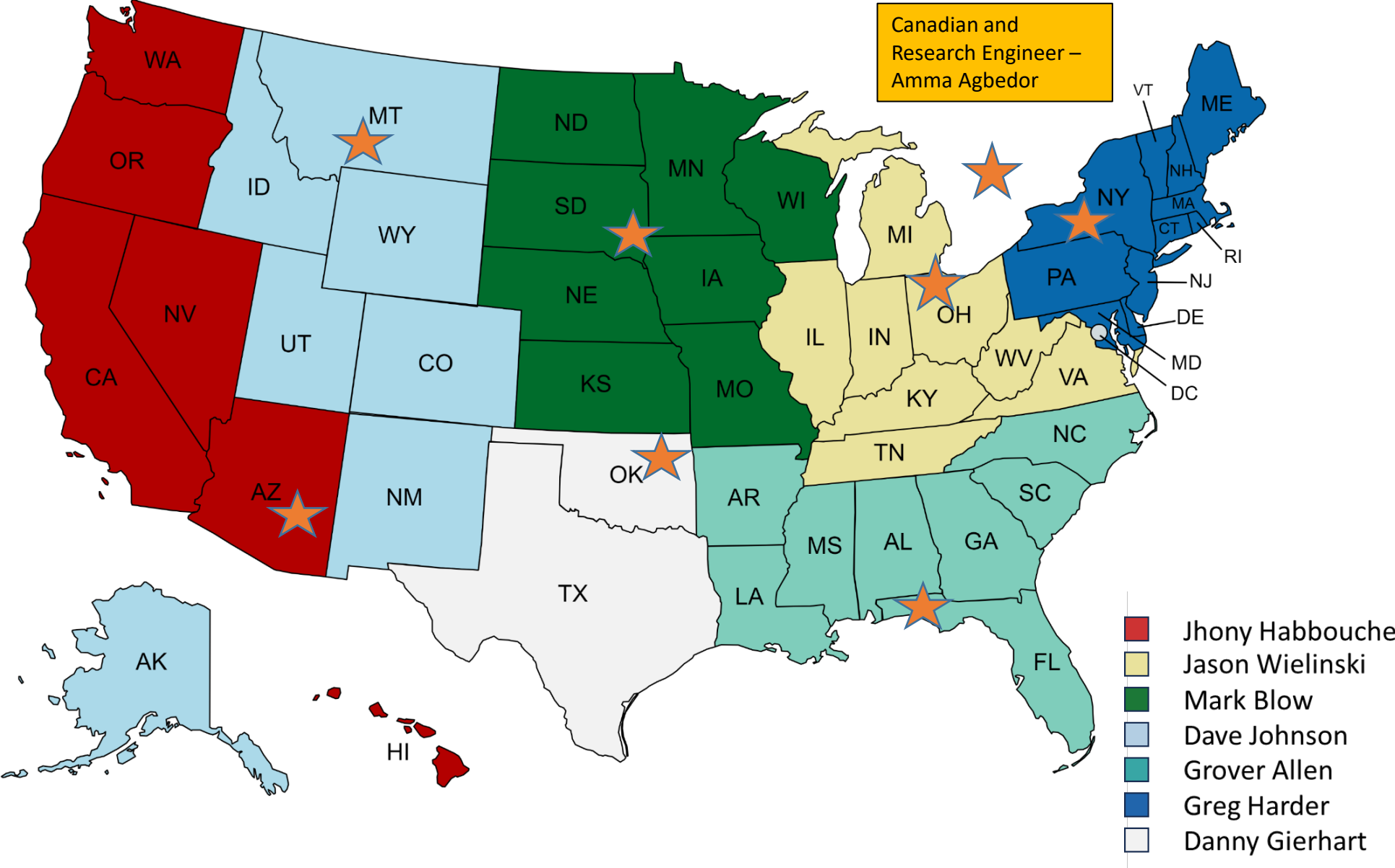




- International association of 130 petroleum asphalt producers, manufacturers and affiliated businesses
- Members represent over 90% of the liquid asphalt produced in North America
- Founded in 1919
- Current Staffing at 33
- Includes 8 Regional Engineers Spread Across U.S. and Canada



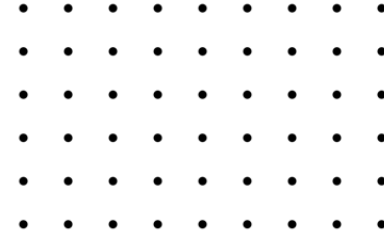
Regional Engineers Alignment







What we do?



PROMOTE QUALITY

Promote benefits and performance of petroleum asphalt pavement through **engineering, education and research.**

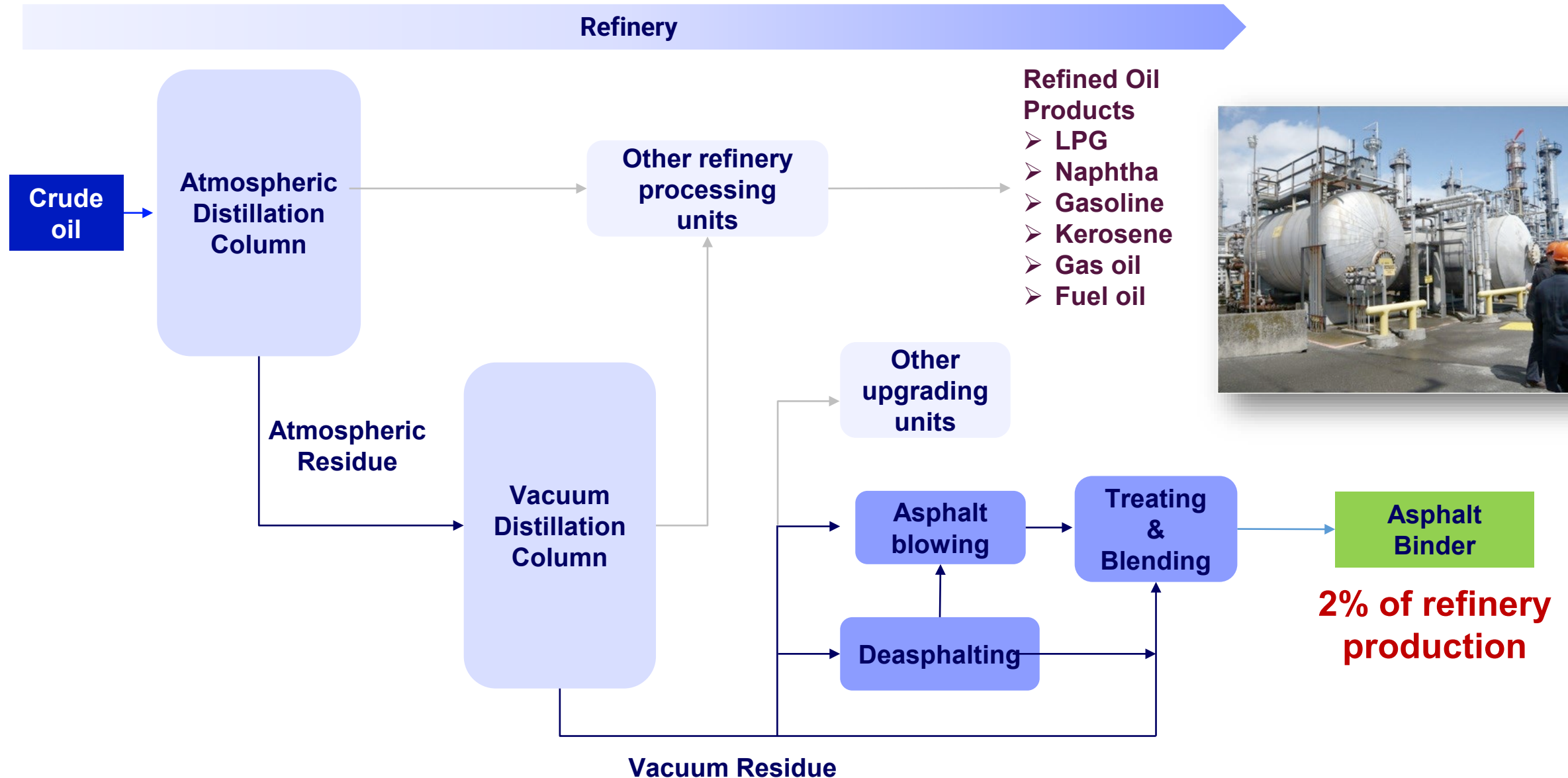
PROVIDE SUPPORT

Recognized throughout the industry as credible, objective experts **providing support** at the **local, state, and national levels.**

“—
| Everything we do is rooted in quality.”

- **Insights on Asphalt Binder Supply**
- **What Might Asphalt Supply Look Like in the Future as the World Transitions to a Low Carbon Future**
 - Wood Mackenzie Study
- **Addressing Concerns of Air Emissions from Asphalt Pavements**
- **New Valuable Resources by AI**
 - Asphalt Paving Handbook
 - Odor Management Tool

Asphalt Production - Refinery



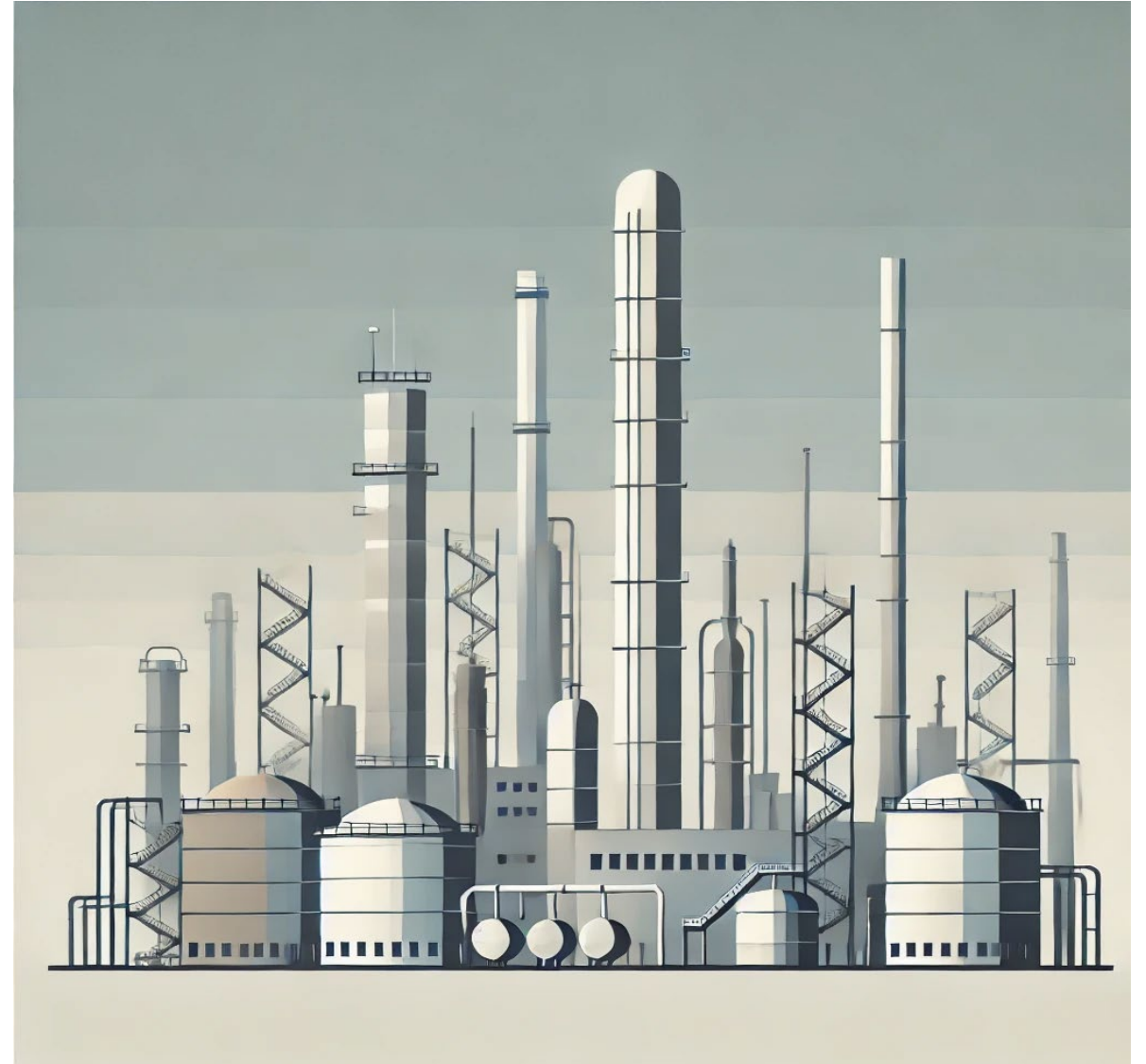
2001:

- 150 “Operable” Refineries in US
- 48 Produced Asphalt (Approximately)

2024:

- 132 “Operable” Refineries in US
- 43 Producing Asphalt (Approximately)

Source: Energy Information Agency, Oil & Gas Journal

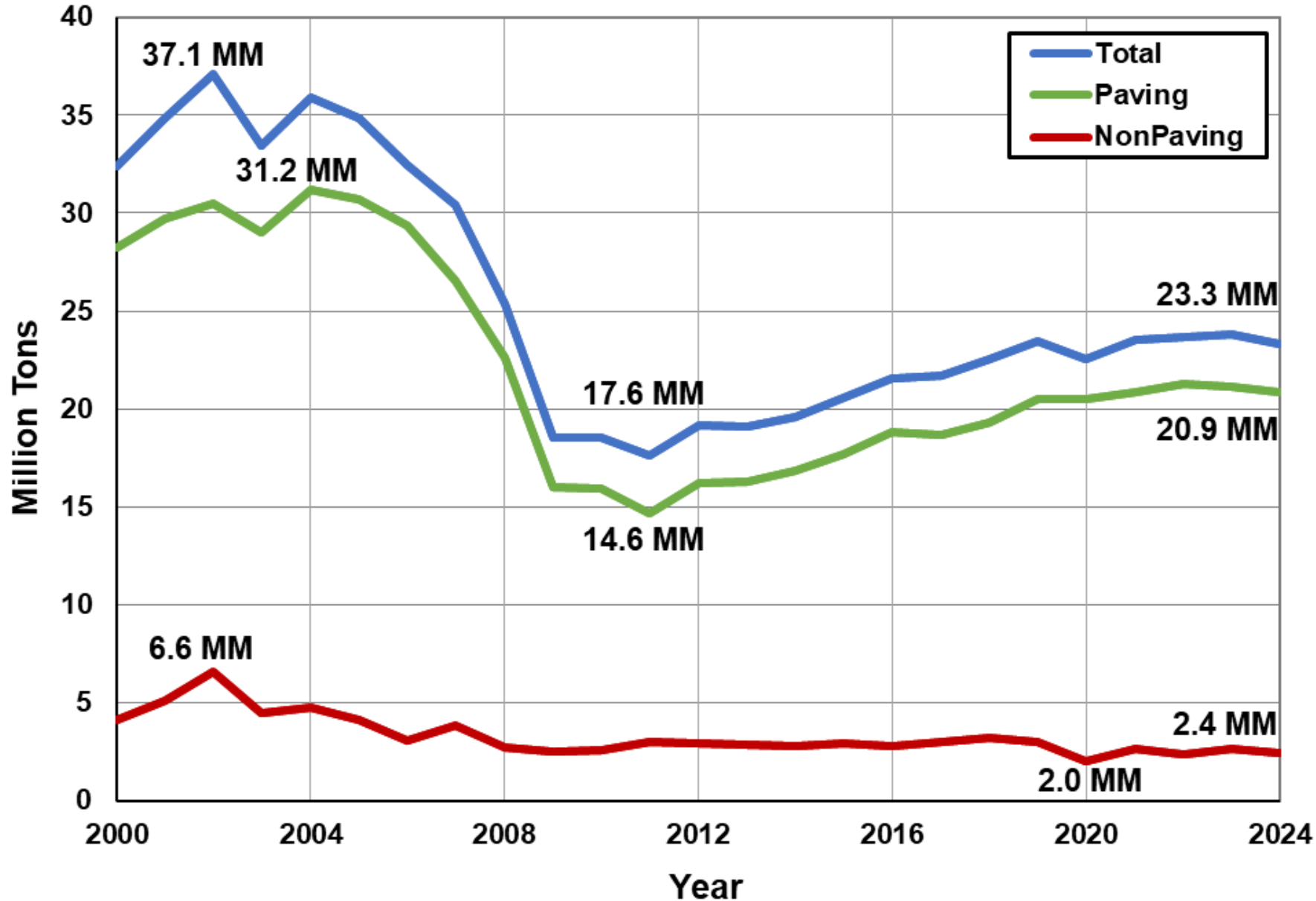


What Impacts Asphalt Production...

- **Refinery economics**
 - Optimize crude and products
 - Asphalt is 2% of the output
- **Demand from end users**
 - Funding from federal, state, commercial activity
- **Specifications**
 - Mix design
 - RAP / RAS
 - Use of modifiers
- **Public agencies still the largest market**
- **Not a supply issue...**
 - Lots of capacity in the system

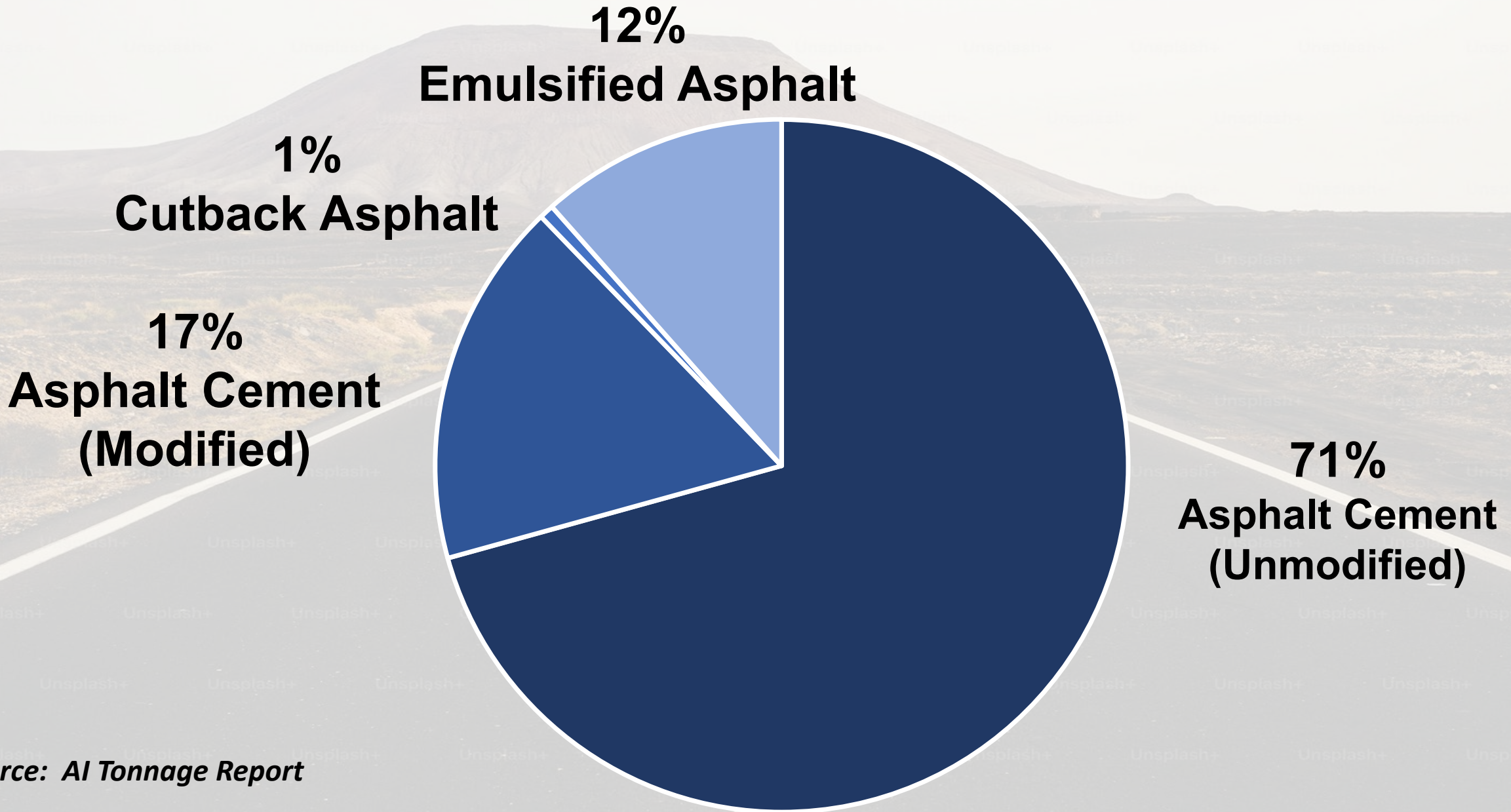


Binder Tonnage History, 2000-2024, US Only



*Source: AI Tonnage Report
A Benefit to AI Members*

2024 Breakdown of Binder for Paving Only (US)

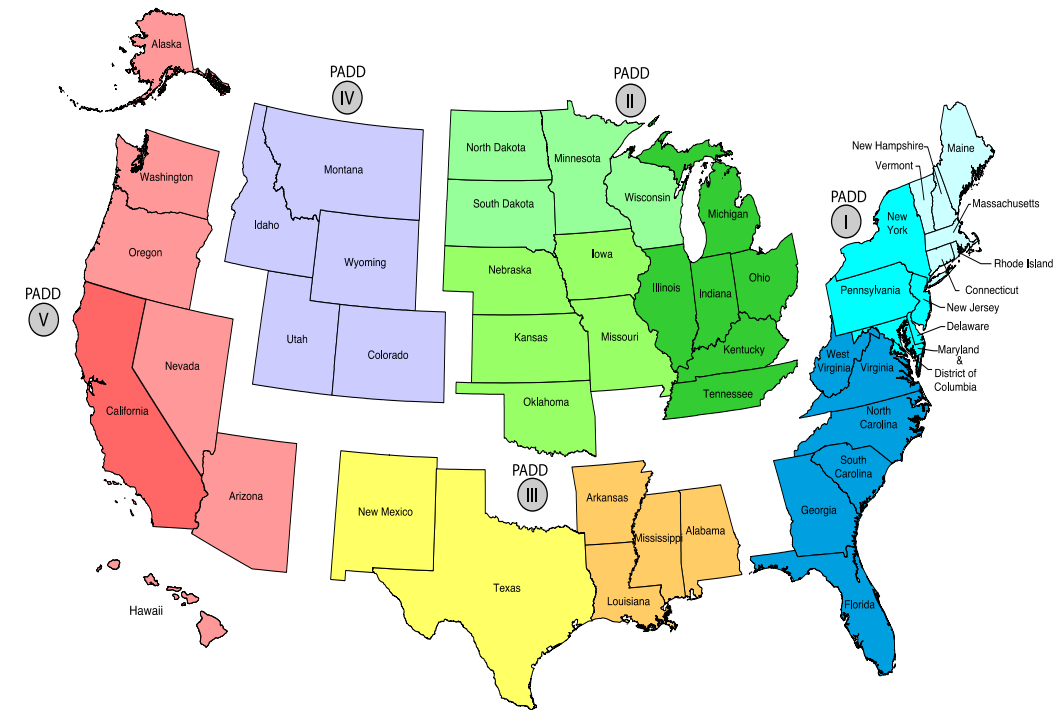


Source: AI Tonnage Report

2024 Data Highlights

- **AI Data**

- Reported by PADD (Petroleum Administration for Defense District)
- 23.3 MM Tons total reported by AI members (US) (all types)
- 2.2 MM Tons Total reported by AI members (Canada) (all types)
- 5.1 MM Tons imported into US (4.9 MM Tons from Canada)
- 90% paving vs. 10% non-paving uses in US

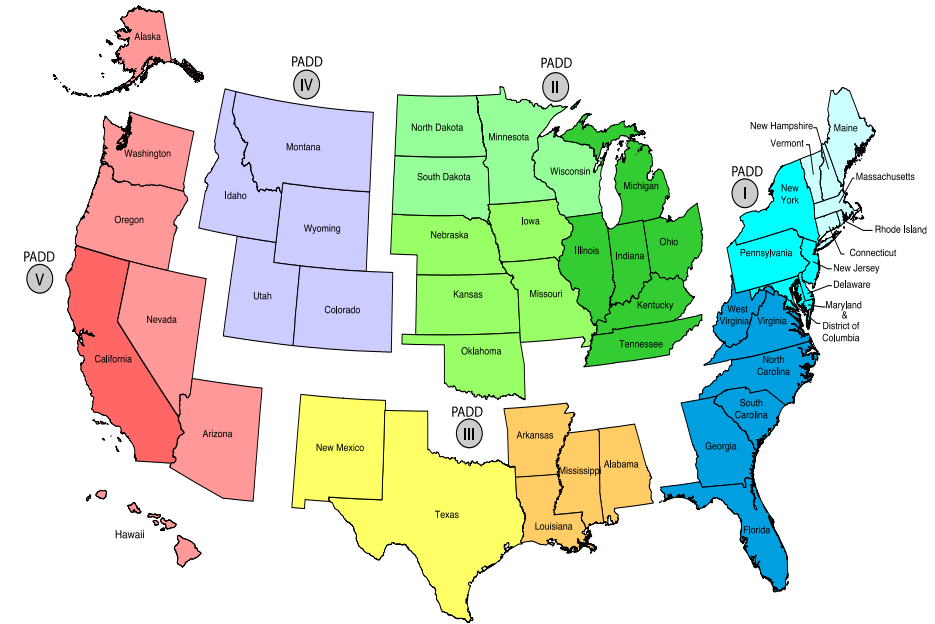


Source: AI Tonnage Report

EIA Reports Refinery Capacity and Production Data

2023

- 38.7 MM tons asphalt production capacity (US)
- 24.2 MM tons produced (US) (all types)
- Produced roughly 2/3rds of capacity
- **Bottom Line: Plenty of Capacity**



Source: EIA Data, 2023

What does tomorrow look like?

- And how might supply be impacted as we transition energy sources?



Analyzing the Petroleum Asphalt Binder Supply-Chain under Energy Transition Scenarios

Strategic Research Project with Wood Mackenzie

Sponsors



Strategic Project with Wood Mackenzie



“Analyzing the Petroleum Asphalt Binder Supply-Chain in a Net Zero World”

• Objectives:

- Wood Mackenzie’s Projected Energy Transition Scenarios
- Relationship Between Energy Transition and Potential Asphalt Binder Supply/Demand
- Relationship Between Energy Transition and Asphalt Binder Supply-Chain Carbon Emissions
- Feedback to Help Industry be More Efficient and Effective Regarding Emissions around Binder

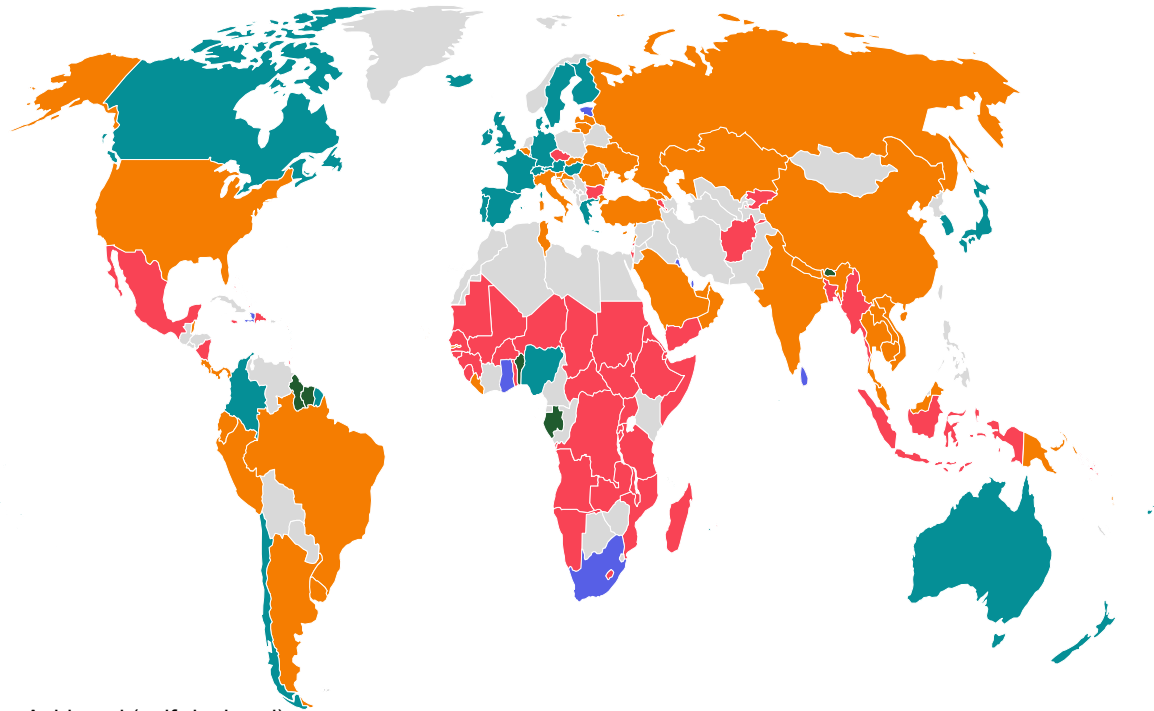


To download report

Global Energy Transition Targets and Emissions Outlook



Status of net zero pledges by country



Announced pledges

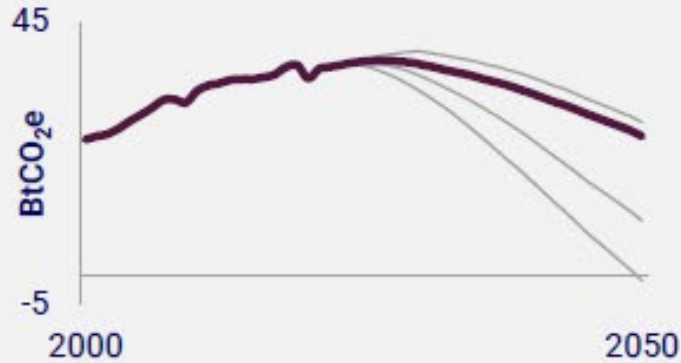
| Country | 2030 target vs baseline | Net Zero year |
|-------------|-------------------------------|---------------|
| UK | 68% decline vs 1990 | 2050 |
| EU27 | 55% decline vs 1990 | 2050 |
| US | 50-52% decline vs 2005 | 2050 |
| Japan | 46% decline vs 2013 | 2050 |
| South Korea | 40% decline vs 2017 | 2050 |
| China | Peak emissions before 2030 | 2060 |
| India | 45% drop in intensity by 2030 | 2070 |

Source: Wood Mackenzie Energy Outlook, Net-Zero Targets

Energy Transition Fundamentals. Three Scenarios.

Base case

2.5 °C



Base case outlook: Steady advancement of current and nascent technologies largely driven by affordability and supply security concerns.

Key 2050 metrics



Investment
US\$ 55
trillion



EV share:
51%



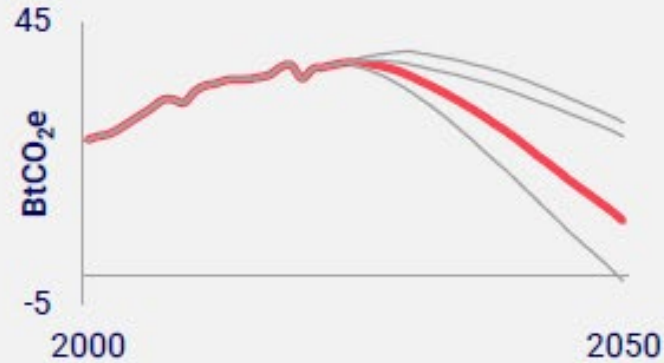
Power mix:
82%
renewables



Carbon price:
\$84/t

Country pledges

2 °C



Scenario: coordinated policy responses to the current energy crisis and geopolitical challenges facing the global economy, building momentum in the 2030s.

Key 2050 metrics



Investment
US\$ 65
trillion



EV share:
71%



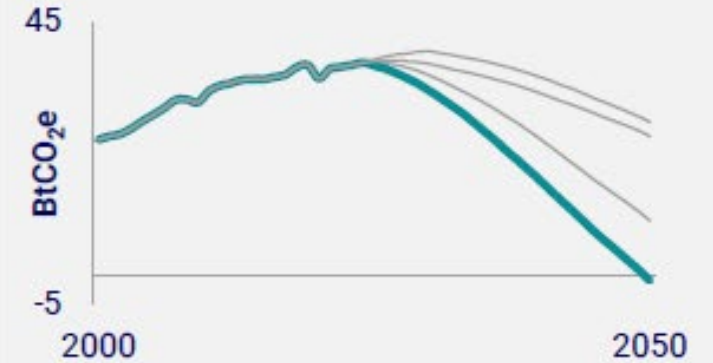
Power mix:
91%
renewables



Carbon price:
\$133/t

Net zero

1.5 °C



Scenario: immediate peak energy, rapid deployment of negative emissions technologies, nuclear, long-duration storage and geothermal.

Key 2050 metrics



Investment
US\$ 78
trillion



EV share:
91%

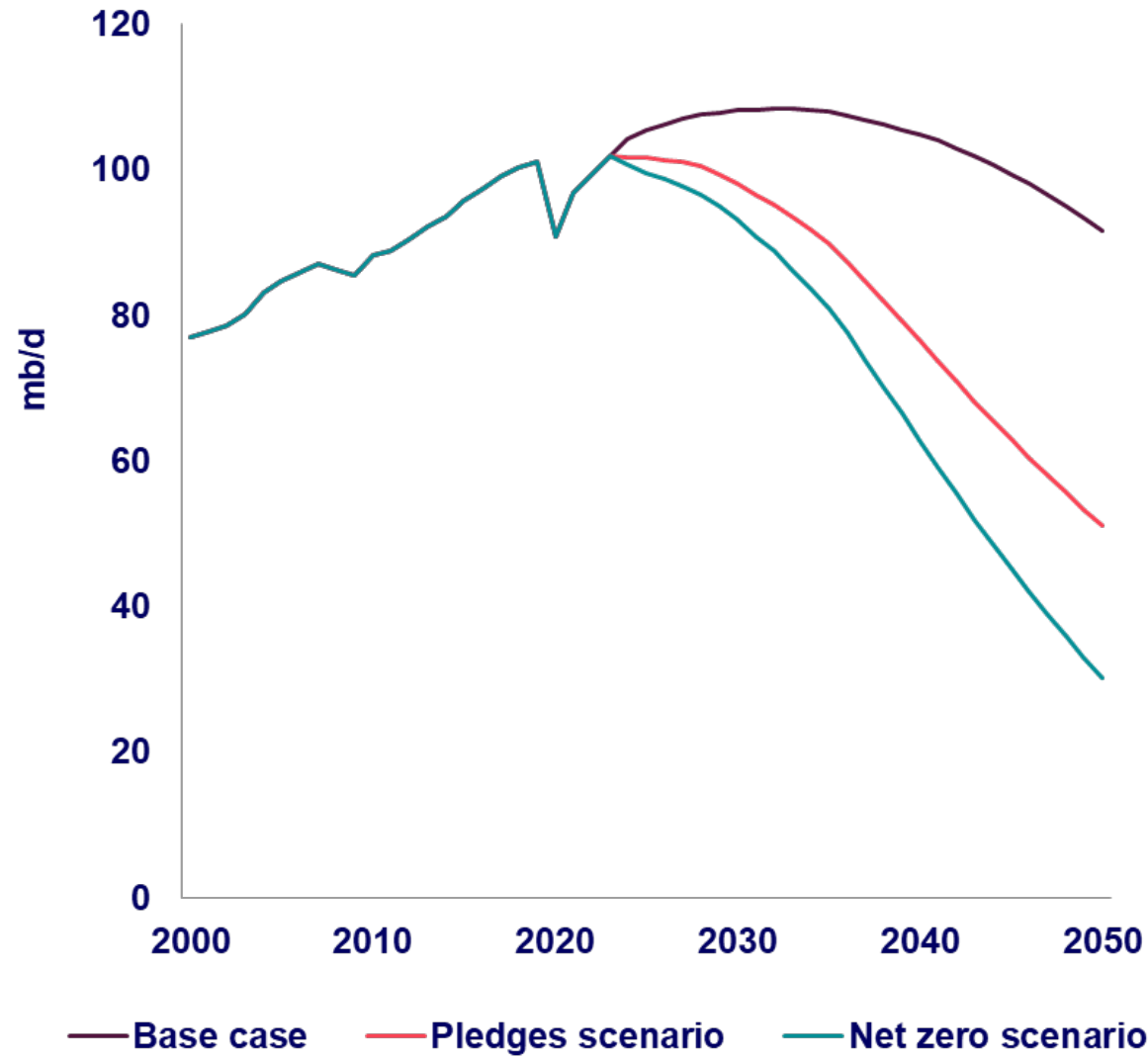


Power mix:
94%
renewables



Carbon price:
\$157/t

Energy Transition and Global Crude Oil Demand, 3 Scenarios



Source: Wood Mackenzie Energy Outlook, Net-Zero Targets

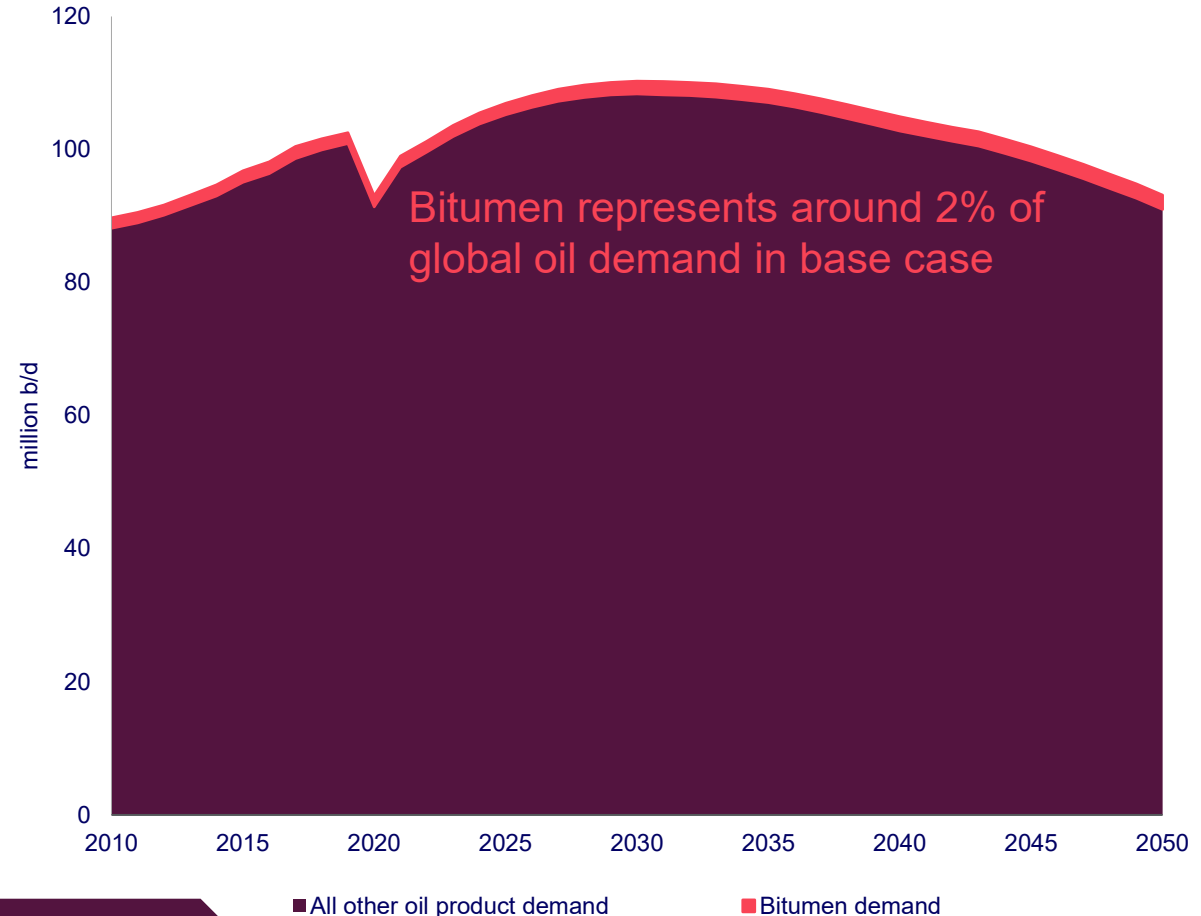
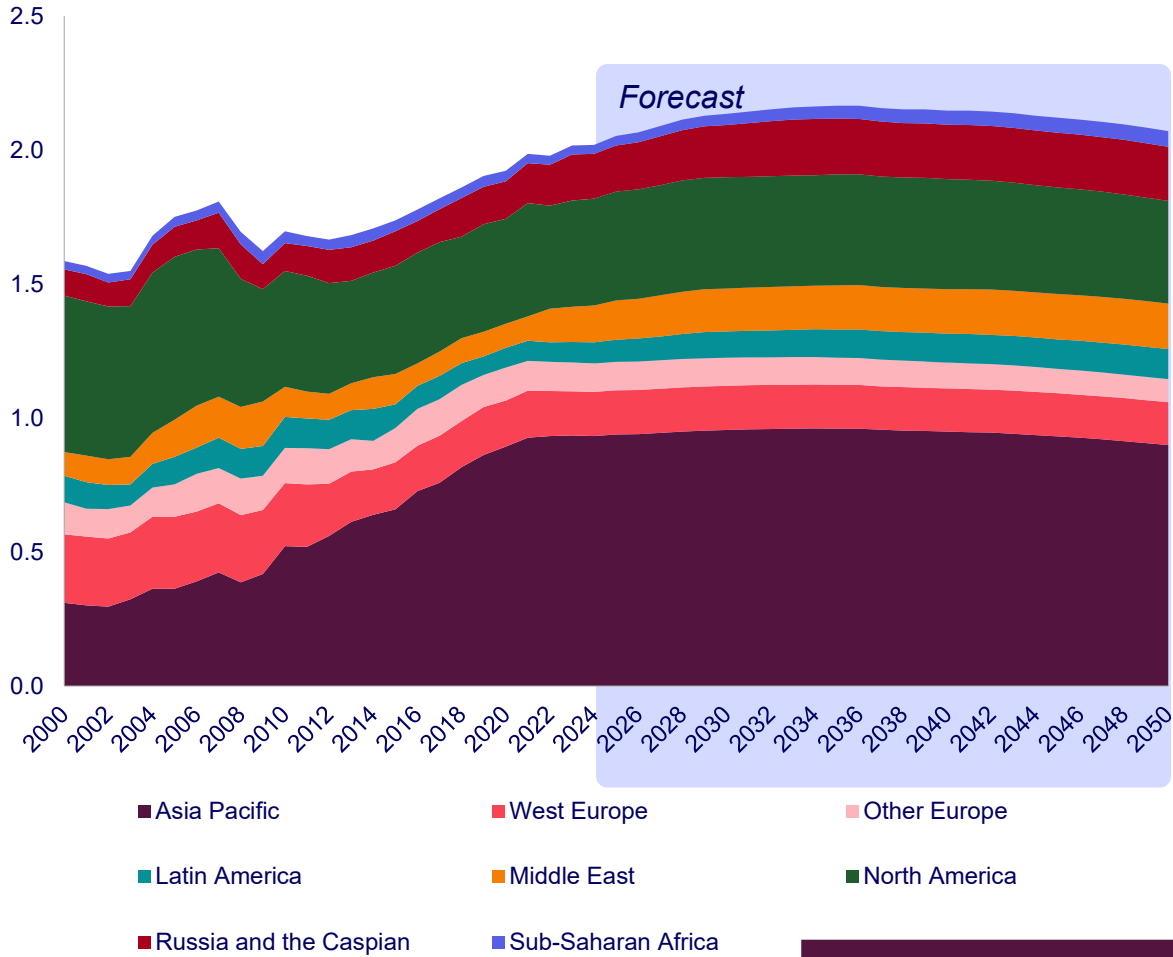
Note: the 'Pledges' and 'Net Zero' scenarios are deterministic, i.e. they show the level of oil demand necessary for the world to reach net zero. Forecasts are subject to uncertainties around policy, technology development, consumer behaviour and other factors

Under Base Case Scenario, Asphalt Demand Constant to 2050

Source: AIF –Wood Mackenzie Study

Global Bitumen Demand

All other oil products demand, global. Bitumen demand shown as pink band.

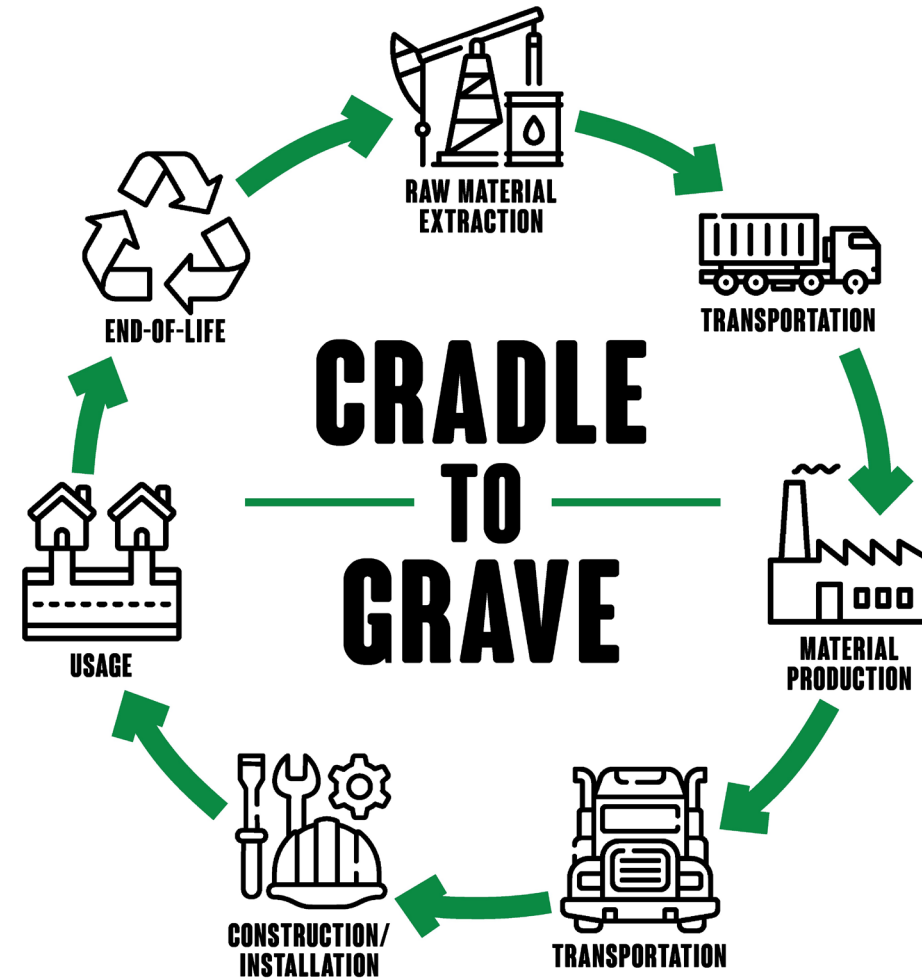


Base case

All other oil product demand

Bitumen demand

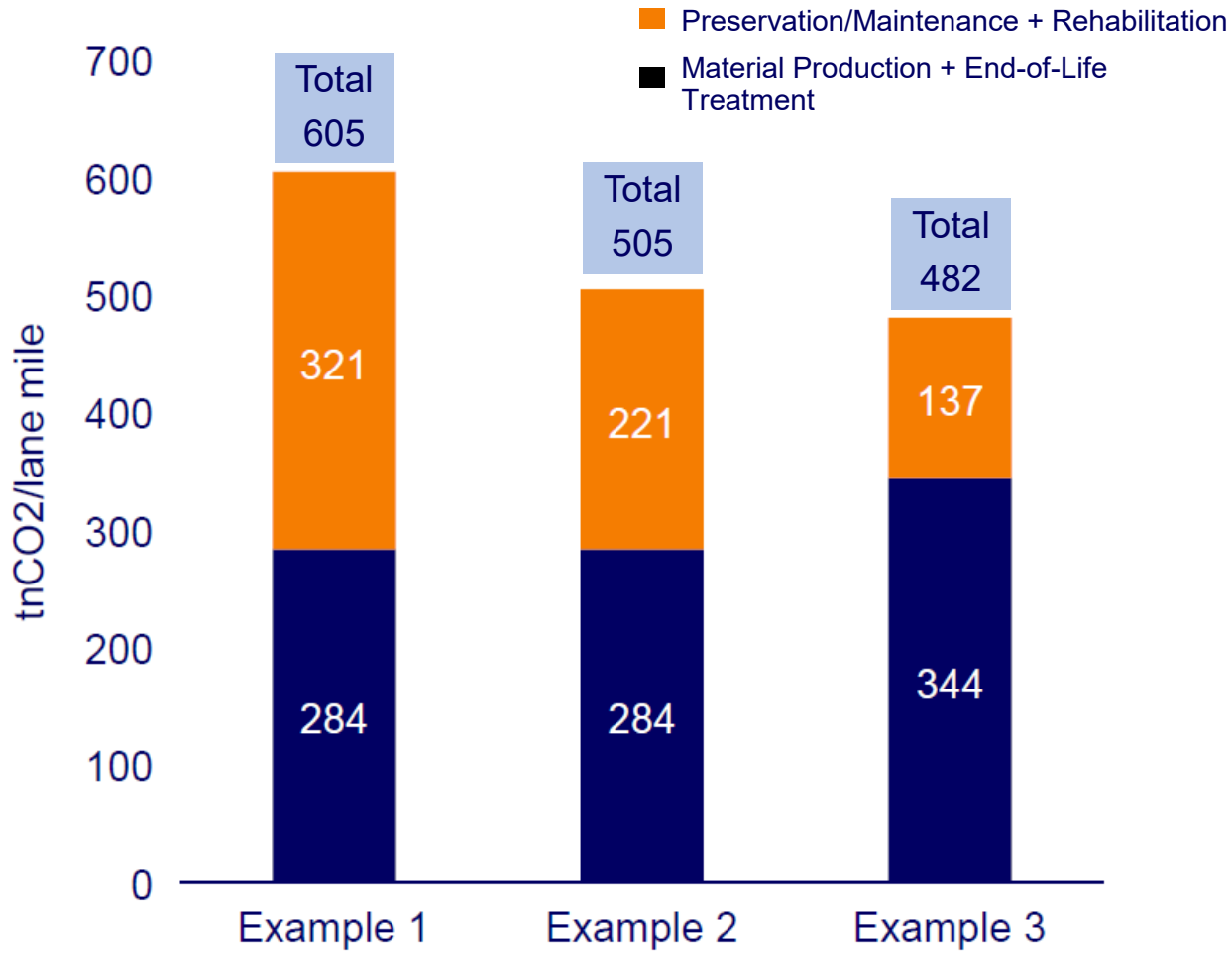
- Unfortunately, today's green public procurement policies determine what materials are low carbon, or not, within the narrow scope of **cradle-to-gate**.
- Must promote **cradle-to-grave** scope, which is a holistic approach
 - A systematic analysis through the entire life cycle of a material.
 - Capture performance differences between material options



One of the example case studies in report illustrates importance of “*cradle to grave*” scope versus just “*cradle to gate*”.

Three Examples (Alternatives) of Pavement Life-Cycle Emissions

Influence of performance and extended service life on cradle-to-grave emissions intensity



Parameters used in cradle-to-grave emissions examples

The 3 examples show the emissions impact of changing a single variable in the asphalt mixture or use phase treatment

| Example 1 – RAP mixture with no preservation treatments | | | | | | | | | |
|---|--------------------|--------|--------|---------|---------|---------|---------|---------|--|
| Mixture | RAP 22% | Year 0 | Year 9 | Year 18 | Year 27 | Year 36 | Year 45 | Year 50 | |
| Initial lay | Reconstruction, 9" | | | | | | | | |
| Use Stage | Mill & Fill, 2.5" | | | | | | | | |
| End-of-life | FDR, 9" | | | | | | | | |

| Example 2 – RAP mixture with preservation treatments | | | | | | | | | |
|--|--------------------|--------|--------|---------|---------|---------|---------|---------|---------|
| Mixture | RAP 22% | Year 0 | Year 5 | Year 15 | Year 20 | Year 30 | Year 35 | Year 45 | Year 50 |
| Initial lay | Reconstruction, 9" | | | | | | | | |
| Use Stage | Slurry seal | | | | | | | | |
| | Mill & Fill, 2.5" | | | | | | | | |
| End-of-life | FDR, 9" | | | | | | | | |

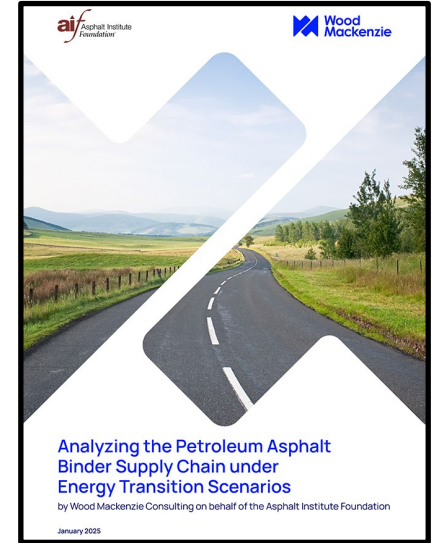
| Example 3 – SBS mixture with preservation treatments | | | | | | | | | |
|--|--------------------|--------|--------|---------|---------|---------|---------|---------|--|
| Mixture | SBS 3.5 | Year 0 | Year 7 | Year 20 | Year 27 | Year 40 | Year 47 | Year 50 | |
| Initial lay | Reconstruction, 9" | | | | | | | | |
| Use Stage | Slurry seal | | | | | | | | |
| | Mill & Fill, 2.5" | | | | | | | | |
| End-of-life | FDR, 9" | | | | | | | | |



Conclusions from Analysis



- **“Base Case” scenario most likely.**
 - Crude demand peaks in 2030, globally and in U.S.
 - 2050 global crude demand decreases just under 10% compared to today.
 - Asphalt binder demand will stay stable thru 2050.
 - Roads will continue to be built and maintained
- **“Pledges” or “Net-Zero” Scenarios Not Likely.**
 - But: refineries could shift productions to meet stable binder demand
- Bottom line: Asphalt supply projected to be stable.
- **Reduction of Carbon Emissions**
 - Durability and pavement management are critical



Quantifying Potential Air Emissions from Asphalt Pavement

Research Funded by Asphalt Institute, NAPA and Eurobitume

- Yale paper in 2020
 - States that hot mix asphalt and roofing asphalts, when exposed to sunlight, generate air pollutants that are a significant concern
- This paper and subsequent papers by multiple authors were cited over 170+ times in scientific literature

Asphalt-related emissions are a major missing nontra-

ditional

precurs

FASTCOMPANY

CO.DESIGN

TECH

WORK LIFE

NEWS

IMPACT

PODCASTS

VIDEO

INNOVATION FESTIVAL 360

SL

09-08-20 | WORLD CHANGING IDEAS

When roads heat up during the summer, the asphalt poisons urban air

When roads get heated by the sun, asphalt can emit greater quantities of secondary organic aerosols than on-road gasoline and diesel vehicles combined.

Response to Yale Research



- Asphalt Institute, NAPA, and Eurobitume funded a research project that quantified air emissions from HMA.
 - AI: \$250K, NAPA: \$125K, Eurobitume: \$100K
- Research was conducted by UC Riverside,
 - Resulting data has been submitted for publication in a peer-reviewed journal to ensure its credibility.

The results will be used to:

- Develop accurate emission factors for quantifying HMA emissions.
- Challenge the validity of findings from Yale and other published research.

Compacted HMA Cores Manufactured by The Heritage Group

3x Neat PG 64-22 asphalt binders:



All Samples Were Blinded

- A. Canadian Crude
- B. Gulf Coast Crude
- C. East Coast Crude

Constant Gradation:

Superpave 9.5 surface mix



Laboratory Compacted:

Superpave 9.5 surface
compacted to 6 % air voids

Compaction



Shipping

Sealed in Teflon bags,
cooled by dry ice, and
shipped to UC
Riverside, CA.

HMA Sample Preparation at HRG





Emissions from HMA cores were captured, speciated and quantified in indoor environmental chambers.

UC Riverside Field Phase of HMA Emissions Testing



UC Riverside Results Compared to Previous Study



| Study | Sample mass (g) | Directly heated object | Binder Accessibility Assumption | Day 1 Mass Loss (%) | Estimated 20-Year Mass Loss (%) |
|----------------------------------|-----------------|--|---------------------------------|-----------------------|---------------------------------|
| Khare et al. (Yale Uni.) | 12 | Bulk | Full binder | 7.10×10^{-2} | 1.05×10^{-1} |
| Kriech et al. (HRG) | 2,000 | Bulk | Partial binder | 1.08×10^{-5} | 4.48×10^{-4} |
| UCR Riverside (Asphalt Industry) | 4,760 | Surface-only heating; heat diffuses inward over time | Partial binder | 1.25×10^{-5} | 2.0×10^{-5} |

Over 5000 times lower than Yale

Over 52,000 times lower than Yale

1

Research conducted by the University of California, Riverside (UCR) indicates that HMA does not represent a significant concern in terms of emissions.

2

Lead author disagrees with findings presented by Yale University, providing data that suggests emissions are up to 50,000 times lower than the figures reported by Yale.

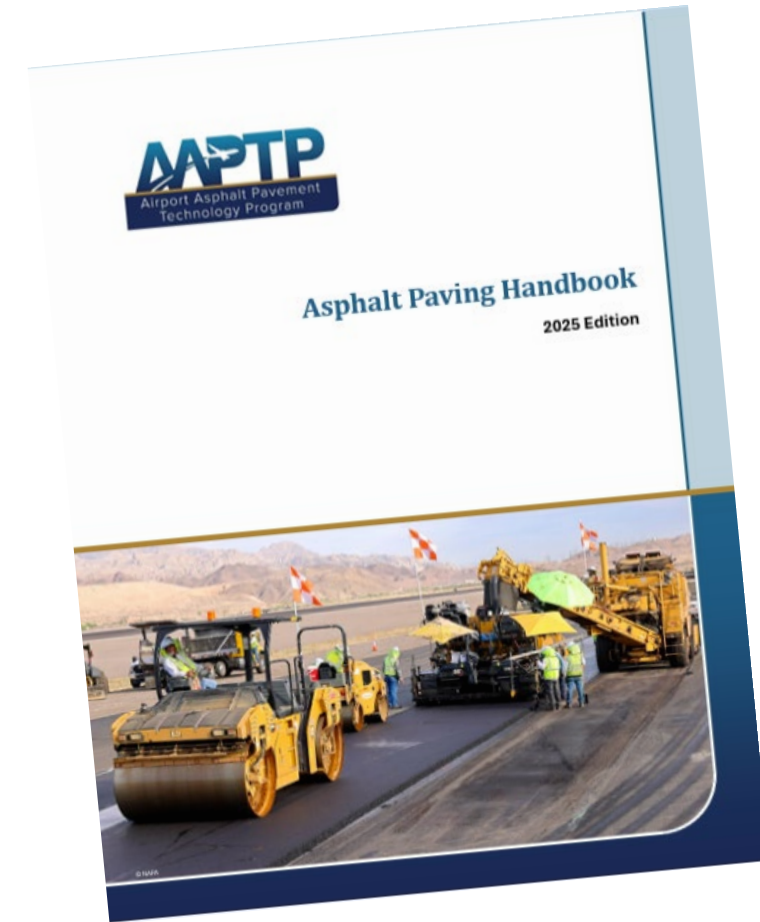
3

AI, in collaboration with NAPA and Eurobitume, are formulating a strategy to effectively communicate these findings to the appropriate stakeholders.

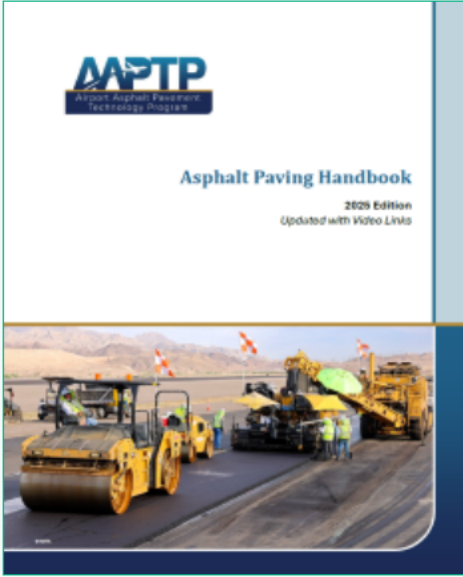
New Asphalt Paving Handbook



- Written by AI Engineering Team
- Free download at NAPA's website
- Published Apr 2025
- 12 Chapters, 319 pages, 176 Figures, 13 Tables
- Smart T.O.C., List of Figures and List of Tables
 - All 3 hyperlinked to ease navigation
- Incorporates latest technologies, equipment, methods, standards
 - Last Handbook was updated in 2000
 - New color images
 - Restructured T.O.C.
- Greater emphasis on airfield paving
 - FAA's P-401 and DoD's UFGS 32 12 15.13



Download New Asphalt Paving Handbook at NAPA's Website



Asphalt Paving Handbook with Videos (AIR-003v, October 2025)

This Handbook provides comprehensive technical information and best practices related to the paving of asphalt mixtures for roadway and airfield projects. Prior editions focused on roadway paving; this 2025 Edition places greater emphasis on airfield paving, with discussion on practices unique to airfield work.

An [Airfield Video Series](#) augments this material with 30 videos demonstrating best practices in the field and featuring perspectives from industry professionals. Filmed at active US airfield projects, these 3- to 5-minute videos are referenced throughout this Handbook, updated in October 2025, and linked in the Appendix.

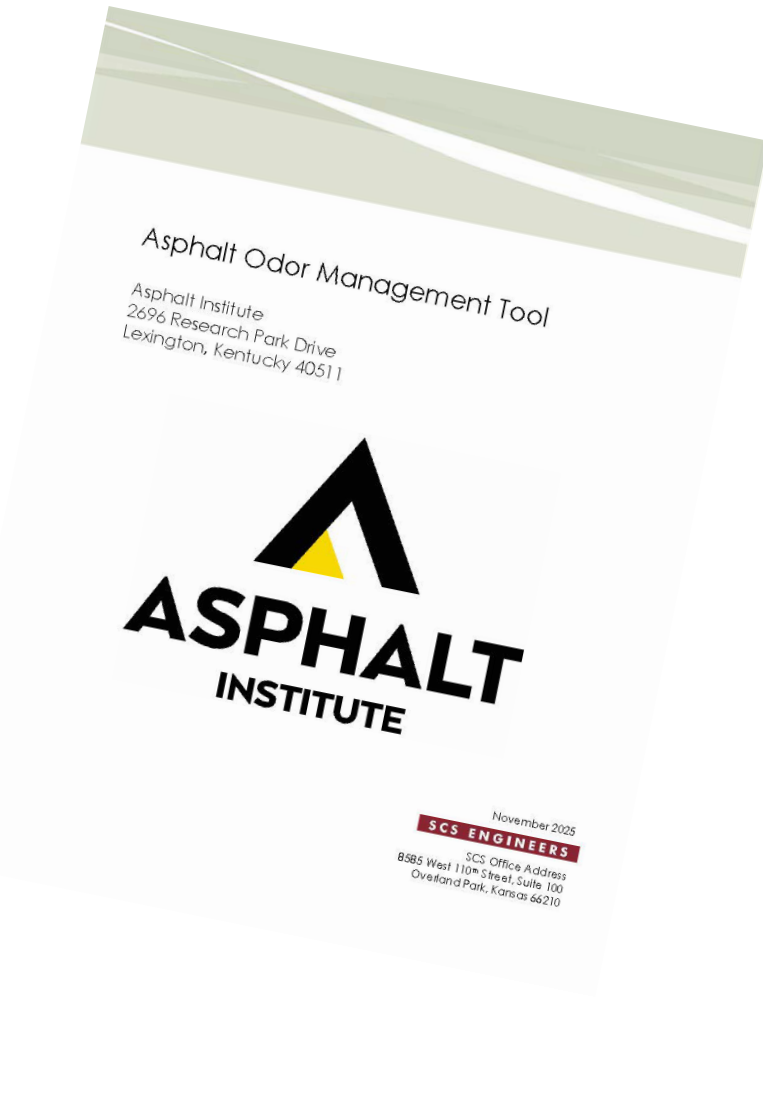
[Download the Handbook](#) [Download Fact Sheet](#)

30 short (2-4 minutes each) YouTube videos on specific key topics covered in the Paving Handbook

Coming Next: Interactive website and app to house the Handbook and videos
User friendly, search features, resource for field personnel

AI's New Odor Management Tool

- user-friendly guide designed to help facilities better understand, evaluate, and control odors from stationary asphalt operations
- explains how odors form and move, how they are perceived and measured, and which technologies can be deployed to mitigate
- detailed insights into odor chemistry and detection thresholds
- actionable solutions to reduce odor impacts
- practical strategies for developing site-specific control plans



- **Also a 2-part Webinar Series**
 - 1) Introduction to Odor**
 - recording available on YouTube
 - 2) Odor Management and Assessment**
 - March 17, 2026



**Scan to download full tool,
access webinar 1, or
register for webinar 2**

AI Member Support...Priceless!

Any Questions?

