# Asphalt Industry's Journey to Net Zero

## PAPA Environmental Seminar

April 12, 2023

Joseph Shacat
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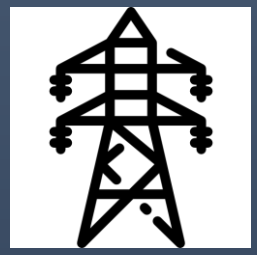
# An Industry-Wide Vision


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

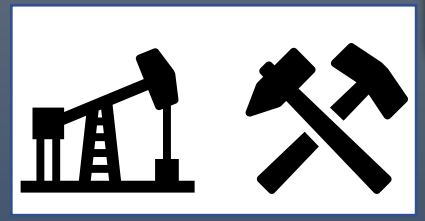
**Mission:** Engage, educate, and empower the U.S. asphalt community to produce and construct net zero carbon emission asphalt pavements

Production and Construction

Electricity



**Net Zero Strategy**



Supply Chain

Quality, Durability, Longevity, Efficiency

# ENGAGE

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
AASHTO
THE VOICE OF TRANSPORTATION

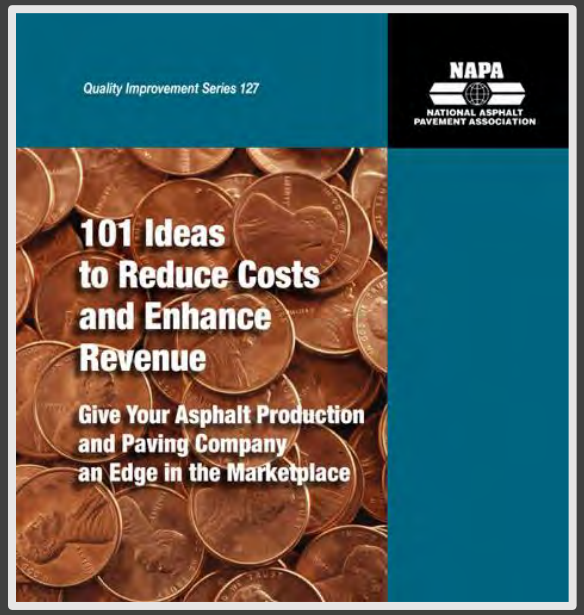
Energy
ENERGY STAR PARTNER

# EDUCATE

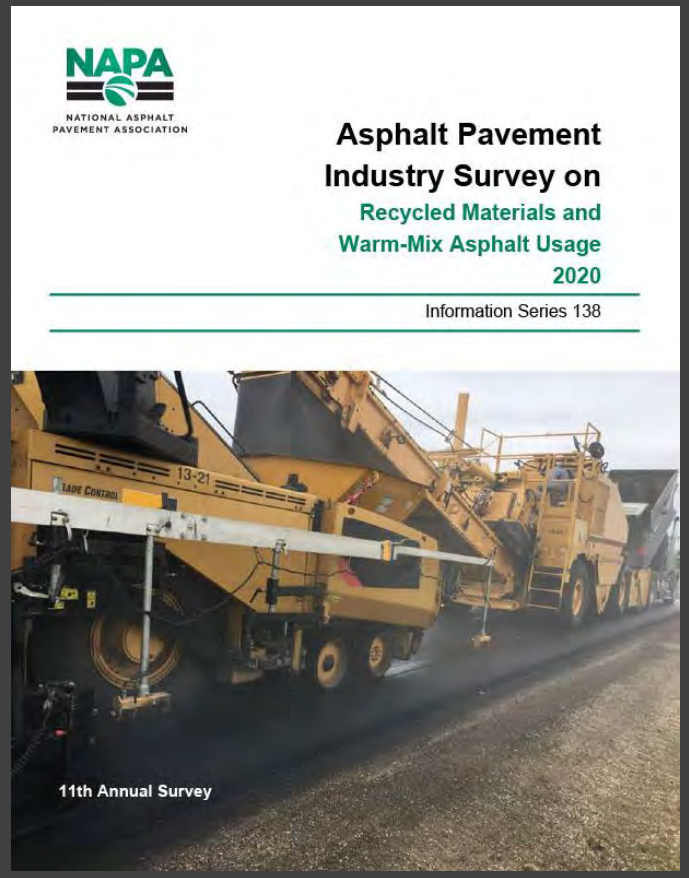
- Podcast Season 5
- Road to Zero Webinar Series
- Publications

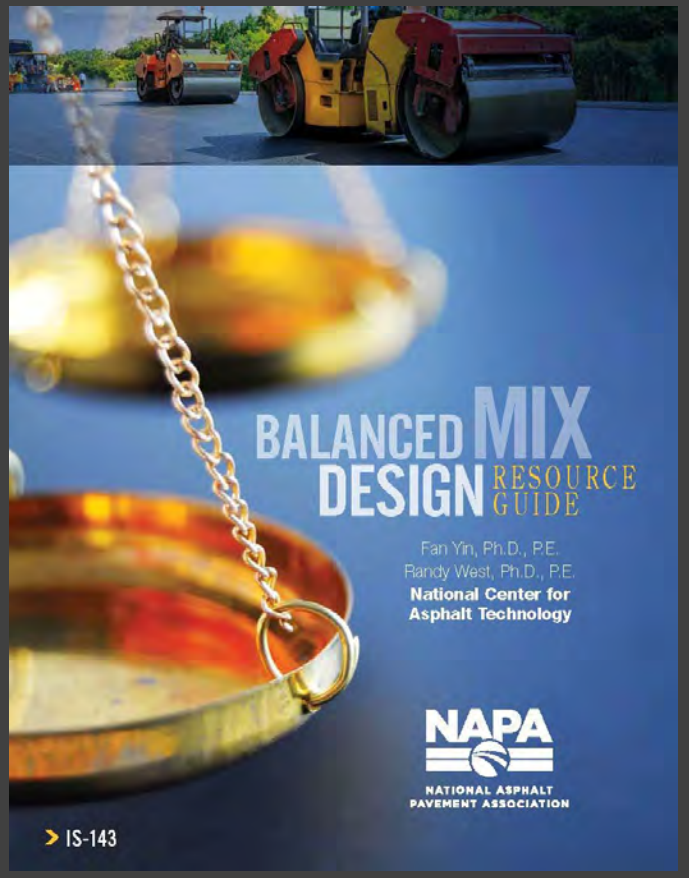


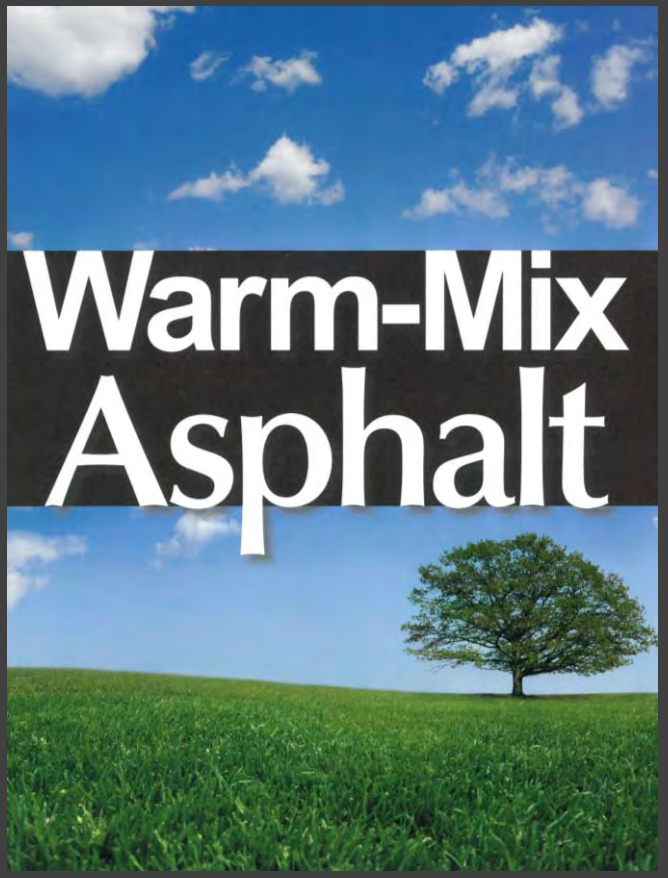




# EMPOWER


NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION
Asphalt Pavement Industry Survey on
Recycled Materials and Warm-Mix Asphalt Usage 2020
Information Series 138
11th Annual Survey


BALANCED MIX DESIGN RESOURCE GUIDE
Fan Yin, Ph.D., P.E.
Randy West, Ph.D., P.E.
National Center for Asphalt Technology
NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION
IS-143


Warm-Mix Asphalt

# 2022 PARTNERS

KRATON

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SURFACE TECH™

VINCI CONSTRUCTION USA

GALLAGHER ASPHALT

COLAS

ASTEC™

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AJAX The Future is Riding on AJAX.®

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PECKHAM INDUSTRIES, INC.

LINDY PAVING

SUMMIT Materials

TEICHERT

Cargill Helping the world thrive

WIRTGEN GROUP

GRANITE

# 2023

HERITAGE CONSTRUCTION + MATERIALS

XBE

Cargill Helping the world thrive

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SAPPHIRE GAS SOLUTIONS

# Frameworks to Quantify GHG Emissions

# Accounting Frameworks

## Business Accounting

- **Financial Accounting**
  - GAAP
  - FASB
  - SEC
- **Tax Accounting**
  - IRS
  - State laws

## GHG Accounting

- **Life Cycle Framework (LCA & EPDs)**
  - ISO Standards
  - Product Category Rules (PCR)
- **Corporate GHG Reporting**
  - GHG Protocol/CDP
  - Task Force on Climate Related Financial Disclosures (TCFD)
  - Science Based Target Initiative (SBTi)

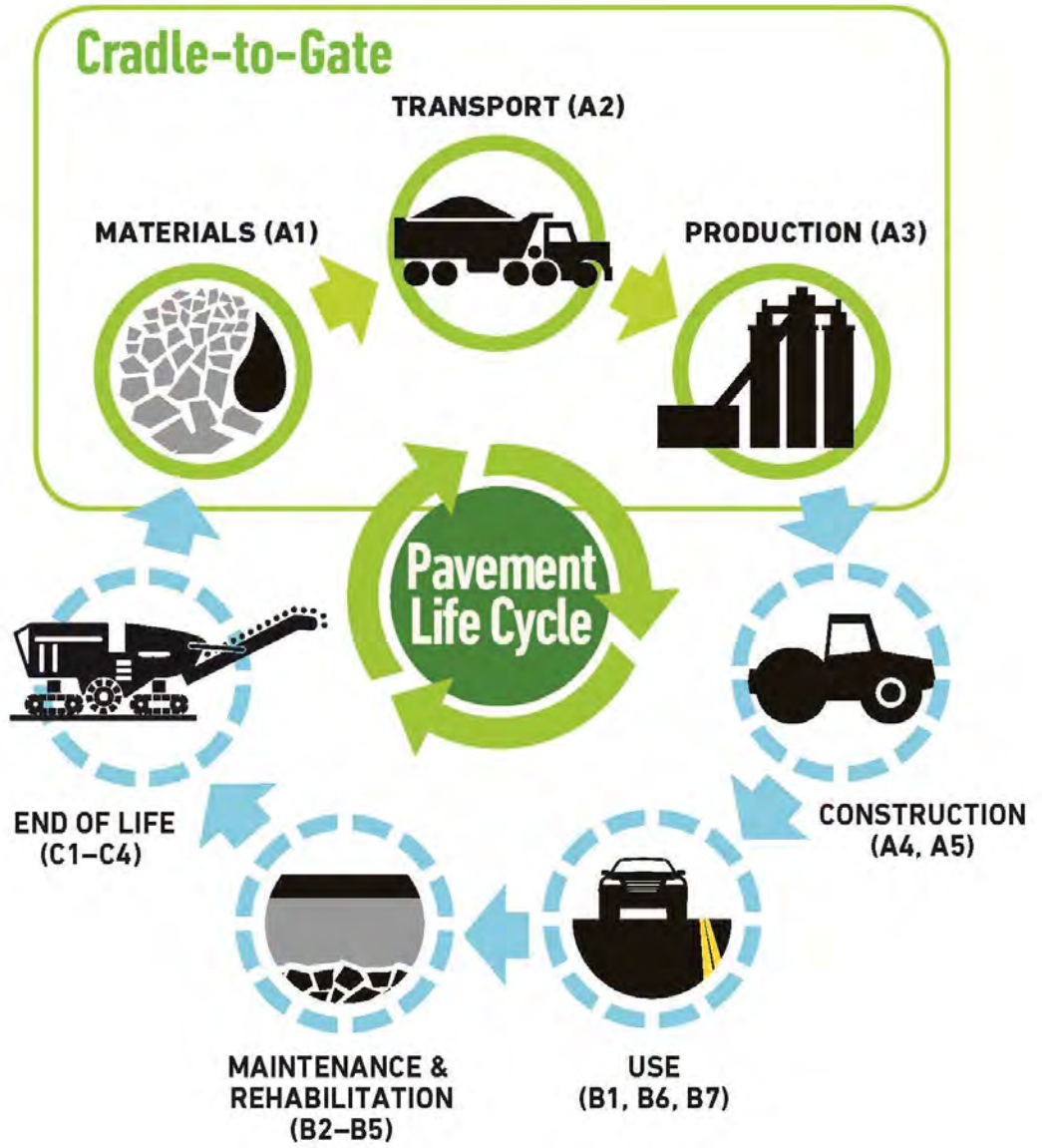
# Life Cycle Framework – LCA and EPDs

**Cradle-To-Grave LCA**

LCA PAVE

**EPDs**

Emerald ECO LABEL



# Corporate GHG Reporting Framework

## Scope 1

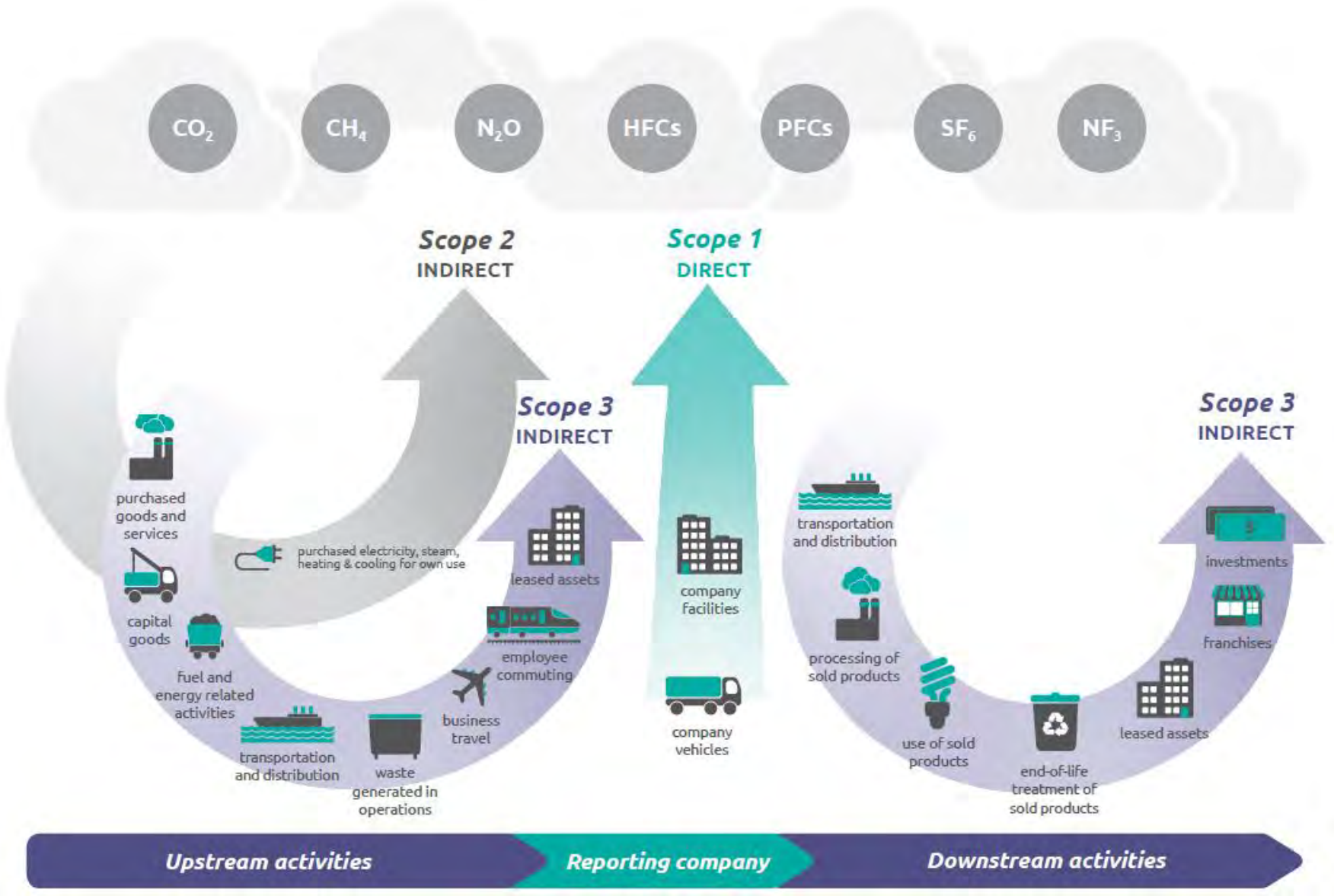
- **Direct Emissions**

## Scope 2

- **Indirect Emissions from Electricity Production**

## Scope 3

- **Other Indirect Emissions**
  - Upstream
  - Downstream



# 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 Standards
  - Product Category Rules (PCR)

- **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) | 0.03 |
| 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

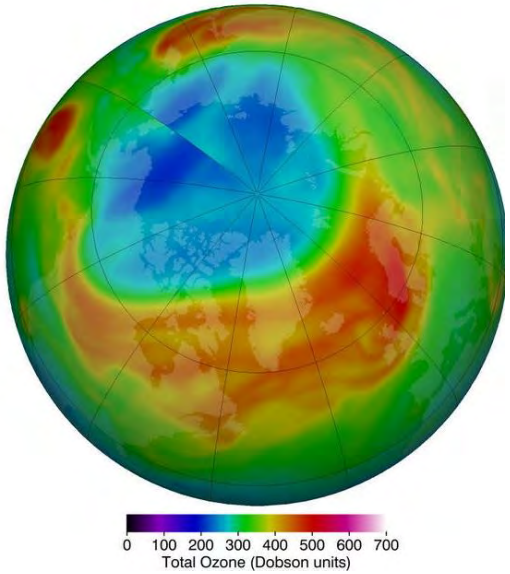
*Source: ISO 14025:2006. **EPDs from different Product Categories should NOT be compared to each other.**

Acidification Potential

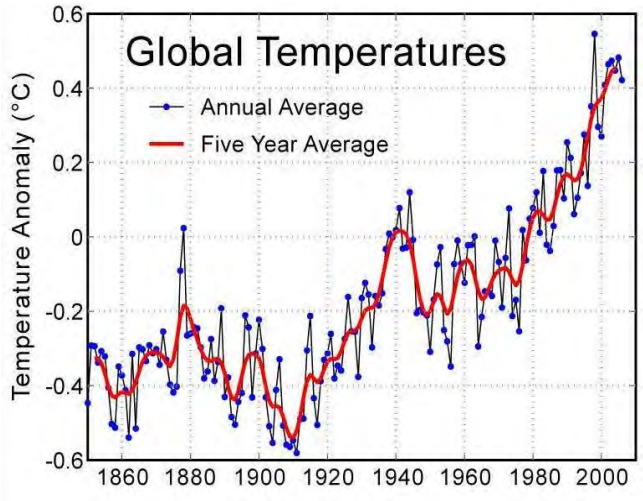
Recycled Materials Use

Smog Potential

Renewable Energy Use




Ozone Depletion Potential




Global Warming Potential

**EPDs report a variety of potential environmental impacts and resource use indicators**

**(these are just a few examples)**

# Understanding Carbon

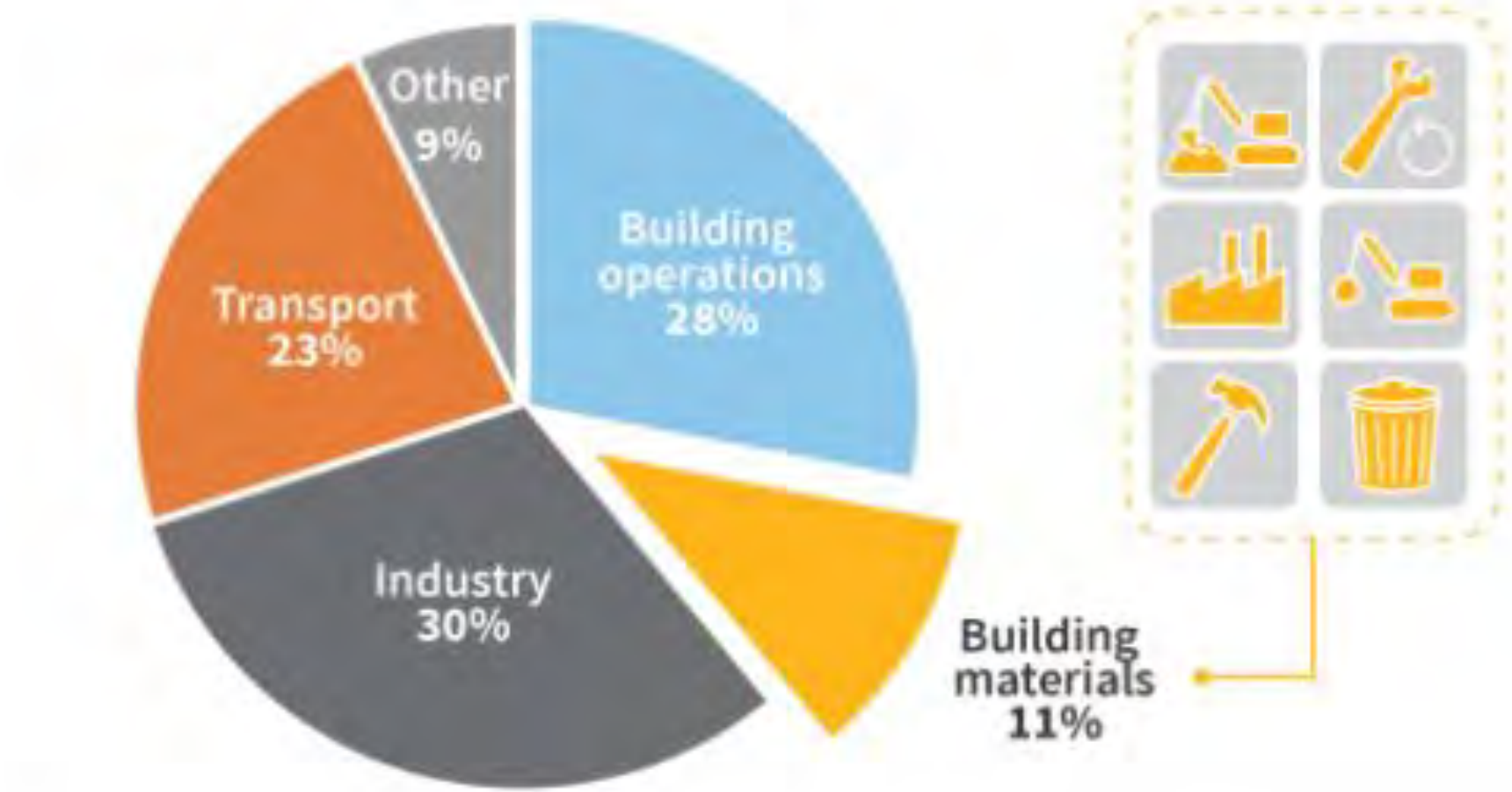

## Embodied Carbon

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




*Global energy-related $CO_2$ emissions.*
*Adapted from the UNEP 2019 Global Status Report*

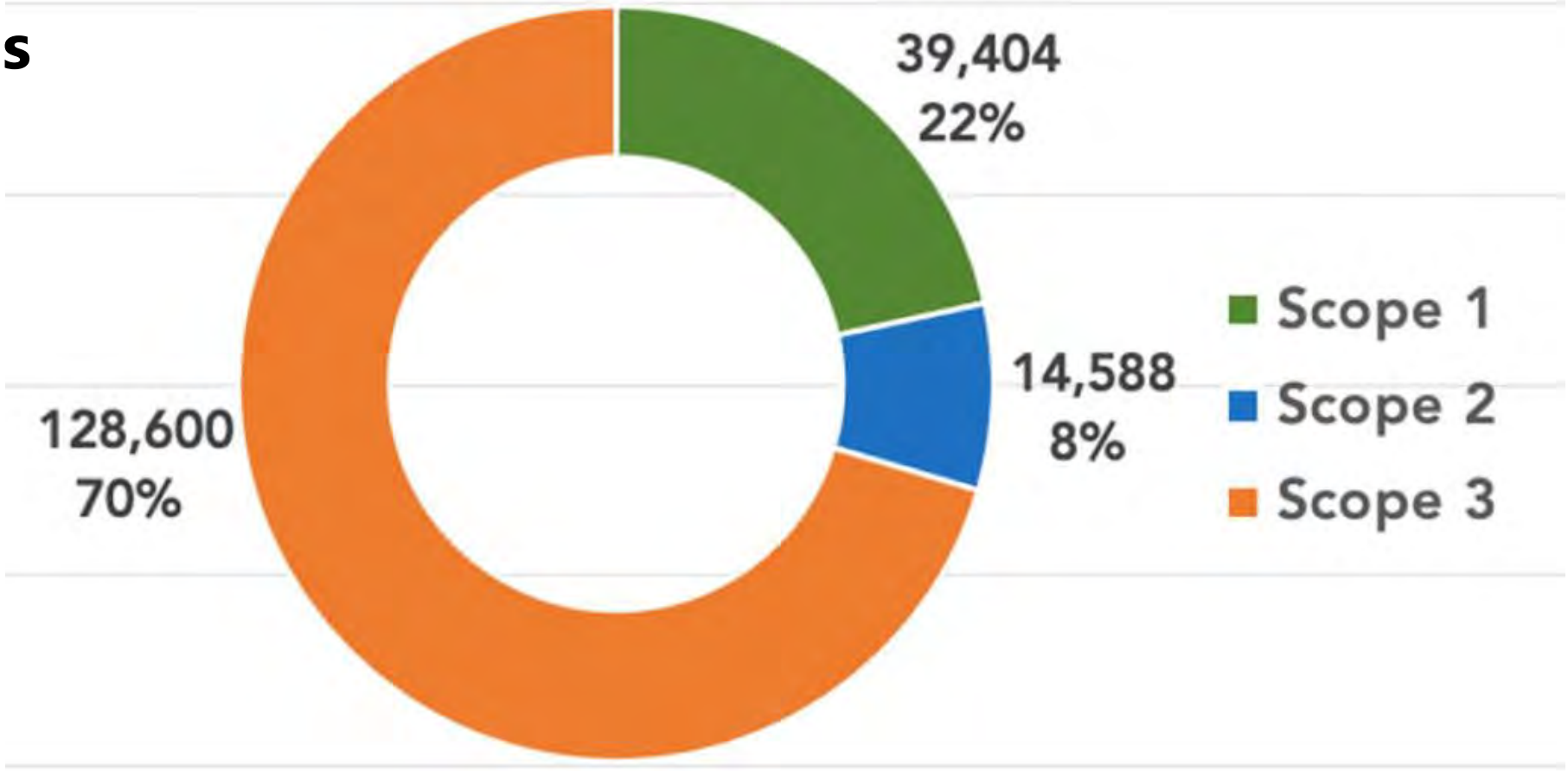
https://carbonleadershipforum.org/what-is-a-buy-clean-policy/



# Globally, embodied emissions from production of building materials are ~11% of total emissions

# Oregon DOT GHG Emissions Inventory (2016-2019 4-yr Average)

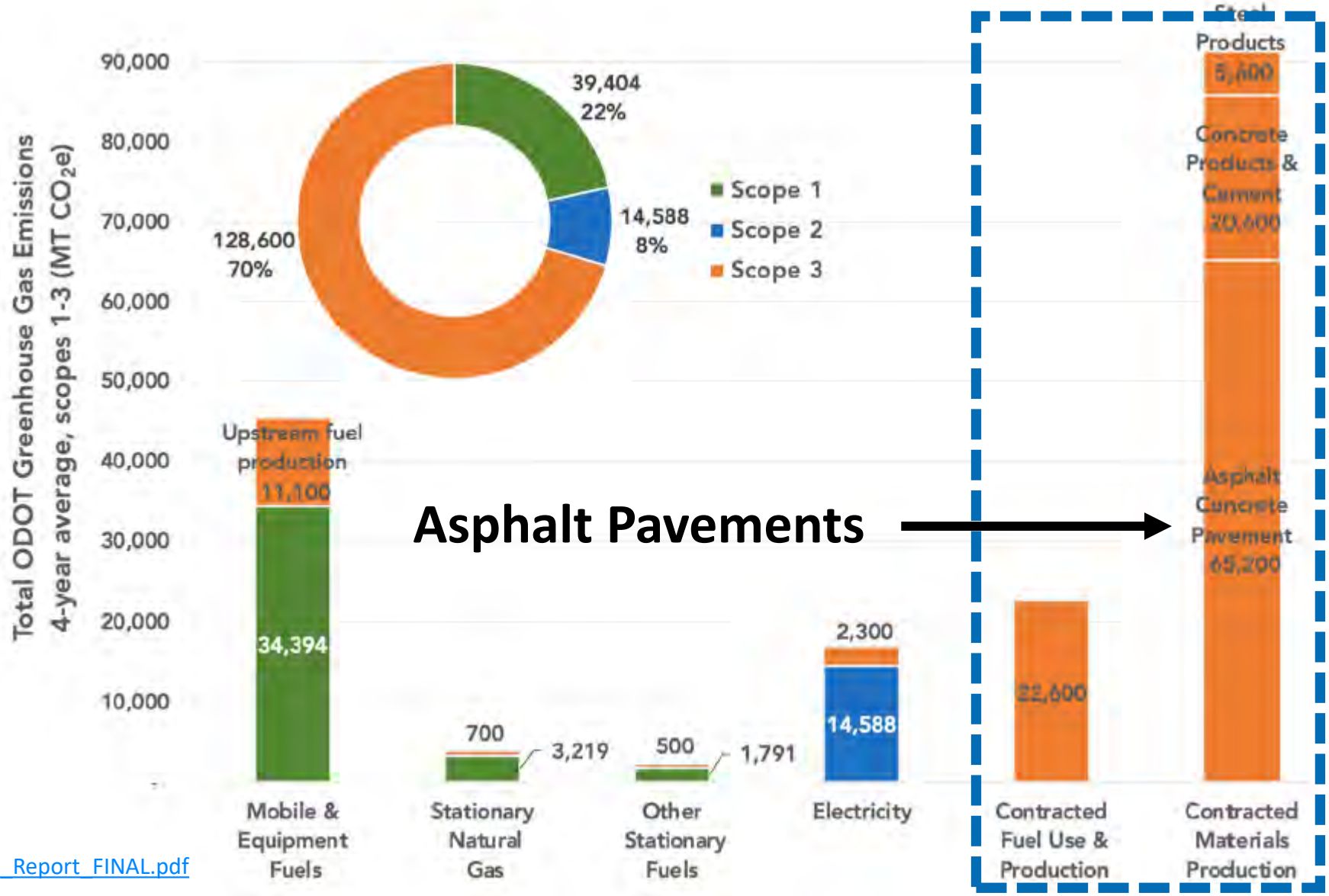
- **Scope 3 = 70% of Total Emissions**




https://www.oregon.gov/odot/climate/Documents/GHG_Report_FINAL.pdf

# Oregon DOT GHG Emissions Inventory (2016-2019 4-yr Average)

- **Scope 3 = 70% of Total Emissions**
- **Asphalt = 50% of Scope 3 Emissions**
- **Asphalt = 57% of Embodied Emissions**




https://www.oregon.gov/odot/climate/Documents/GHG_Report_FINAL.pdf

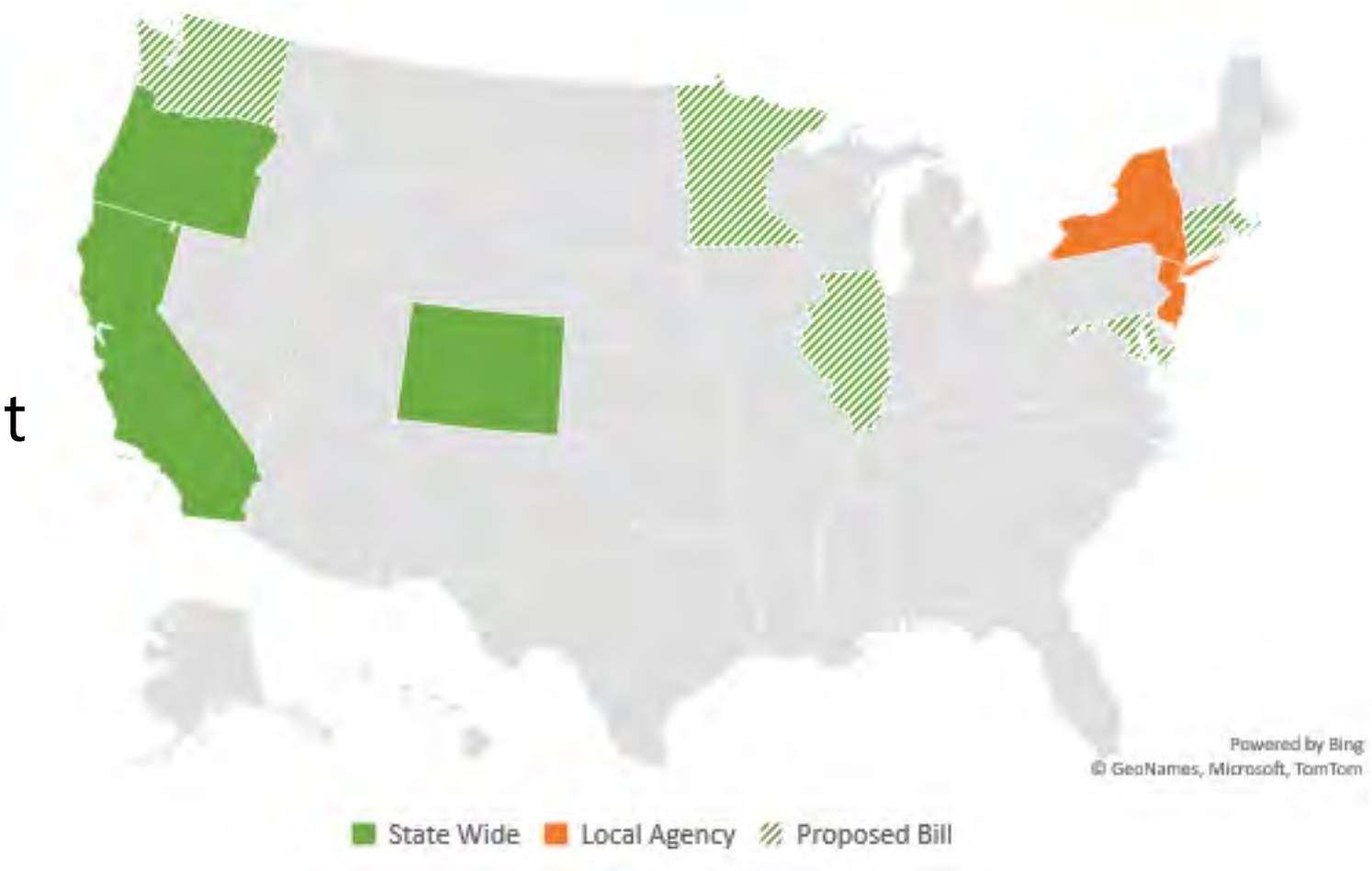
# What's Happening at the Policy Level?

# “Buy Clean” Legislation

**Jurisdictions with Buy Clean policies that include asphalt mixtures**

**Common Themes:**

- Require contractors to submit EPDs
- Develop policies to reduce embodied carbon




## 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
  - Develop a Buy Clean Policy based on EPDs

# Environmentally Preferable Asphalt and Standard

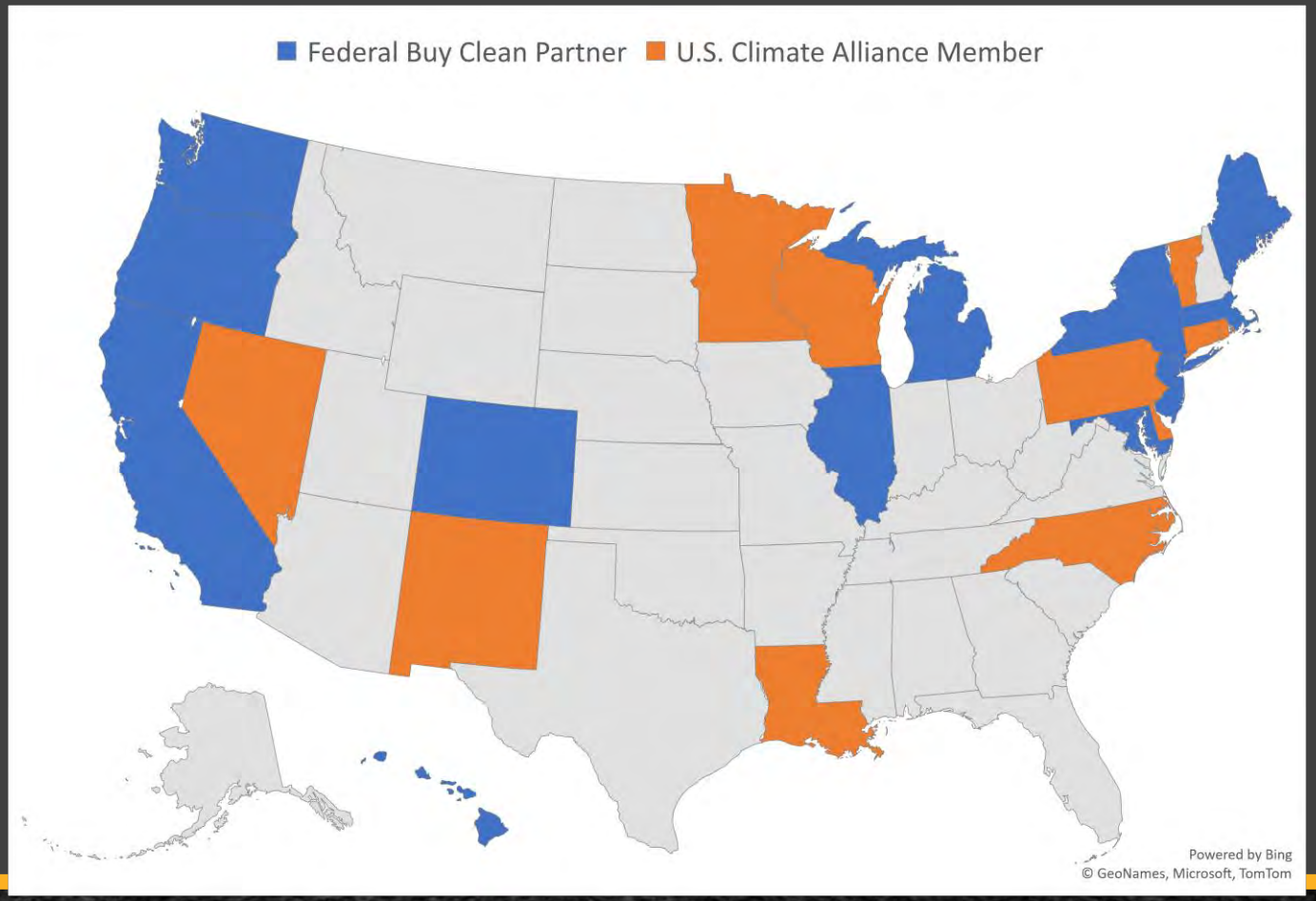
- Federal office buildings, courthouses, and land ports of entry
- Requirements
  - Submit an EPD for each mix
  - Use 2 environmentally preferable techniques
    - At least 21% RAP content
    - Warm mix technology (reduced onsite mix temperature)
    - Non-pavement recycled content (roof shingles, 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

## 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

# FEMA 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

# DRAFT Low Carbon Material Standard

- Federal office buildings, courthouses, and land ports of entry

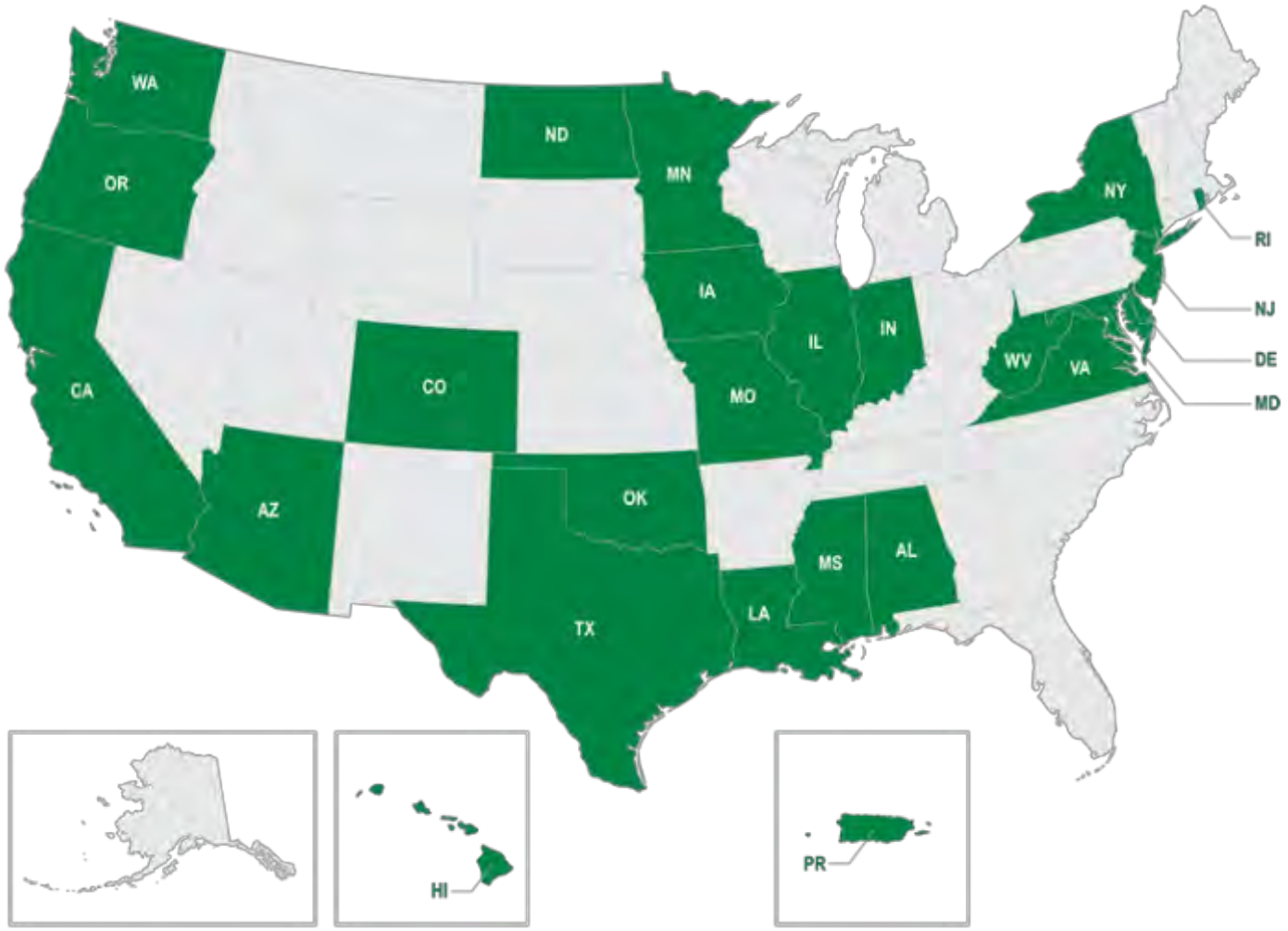
| GSA IRA Limits for<br>Low Embodied Carbon Asphalt - Jan. 2023<br>(Uncertainty-Adjusted GWPs, in kilograms of carbon dioxide equivalent per metric ton - $kgCO_2e/t$) | | |
|---|---|---|
| **Top 20% Limit** | **Top 40% Limit** | **Average or Better Limit** |
| **62.8** | **74.0** | **85.0** |

- ~~"Uncertainty adjustment" is arbitrarily assigned~~
- Same limits apply to all mix types

U.S. Department of Transportation
Federal Highway Administration

# FHWA Climate Challenge

- **30+ proposals from 27 agencies (including 2 local agencies)**
  - Education, implementation, benchmarking, fundamental research projects
- **Providing technical and funding ($7.1 million) assistance**



U.S. Department of Transportation
Federal Highway Administration

Every Day Counts
Innovation for a Nation on the Move

# EDC-7 (2023-2024)

- EPDs for Sustainable Project Delivery
- Enrollment period for State DOTs opens in April 2023

# 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


# Federal Acquisition Regulation (FAR)
## Proposed Rulemaking

**Significant Contractors**

- $7 – 50 million in annual federal contracts
- Must report Scope 1 & 2 emissions through CDP

**Major Contractors**

- > $50 million in annual federal contracts
  - Report Scope 3 emissions through CDP
  - Disclose climate risks through TCFD
  - Set science-based emission reduction targets validated by SBTi

# What is industry saying about EPDs?

# *Priority Targets & KPIs:*

# *Have EPDs available for 50% of our materials facilities by 2025*

**Granite Construction**

**- 2021 Sustainability Report**

https://www.graniteconstruction.com/sites/default/files/inline-files/Granite-2021-Sustainability-Report.pdf

*“We are working with [NAPA] to generate EPDs for our fixed asphalt plant sites across the Summit enterprise.”*

**Summit Materials**

**- 2022 Investor Day presentation**

https://s201.q4cdn.com/127035939/files/doc_presentations/2022-Elevate-Summit_ID-Presentation_vFINAL_3.pdf

*“We encourage Congress to rely on EPDs for current and future legislation concerning low emission and low carbon materials.”*

**Dwayne Boyd**
**President, Midsouth Region, CRH Americas Materials**
**March 28, 2023**

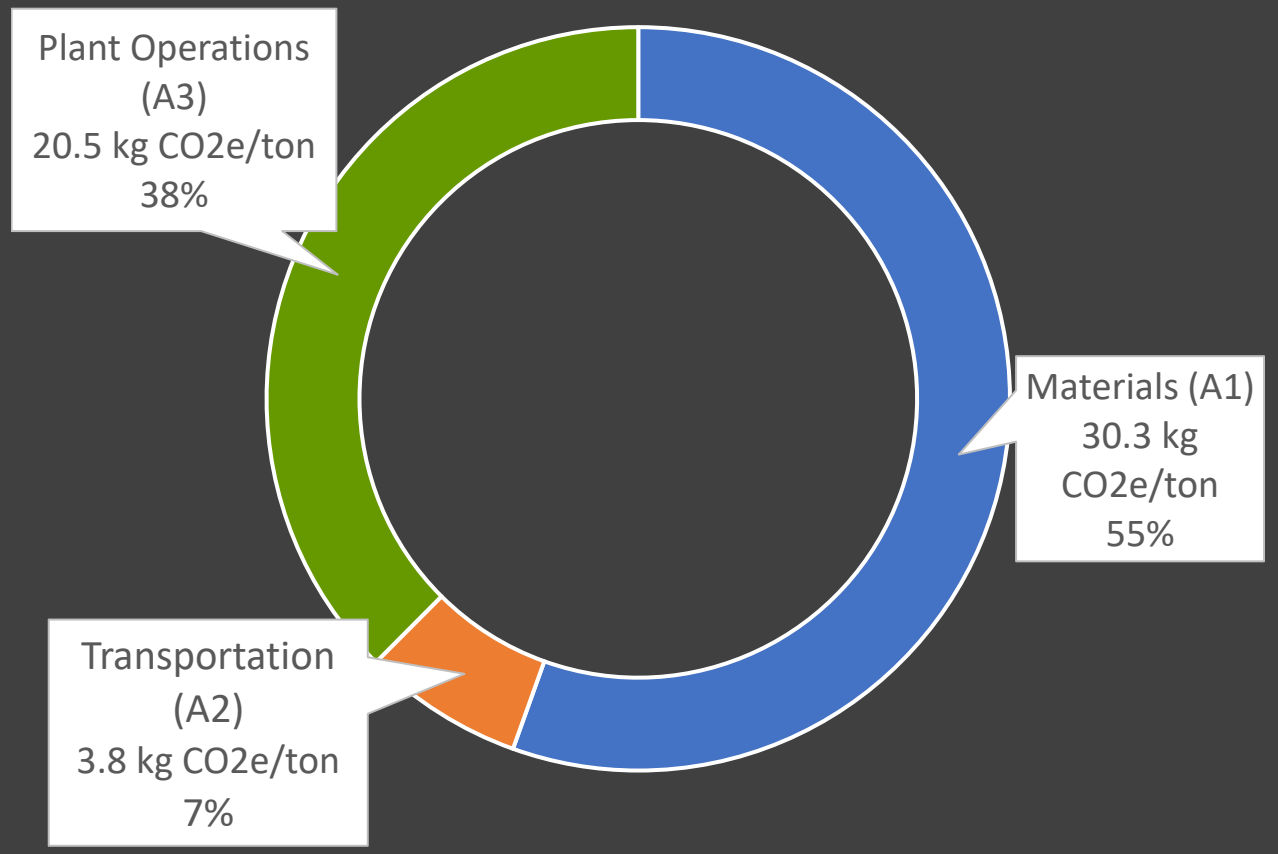
**- Testimony to House Transportation and Infrastructure Subcommittee on Highways and Transit**

https://docs.house.gov/meetings/PW/PW12/20230328/115557/HHRG-118-PW12-Wstate-BoydD-20230328.pdf

# Levers to Reduce Emissions (and save money)

# Simple Mix from a Typical Plant

- **Materials (A1)**
  - 95% aggregates
  - 5% asphalt binder
- **Transport (A2)**
  - 22 miles by truck
- **Plant Energy (A3)**
  - Burner fuel – Natural Gas
  - 289,000 Btu/ton
  - 3.3 kWh/ton – Average grid




Total = **54.7 kg CO2e/ton**

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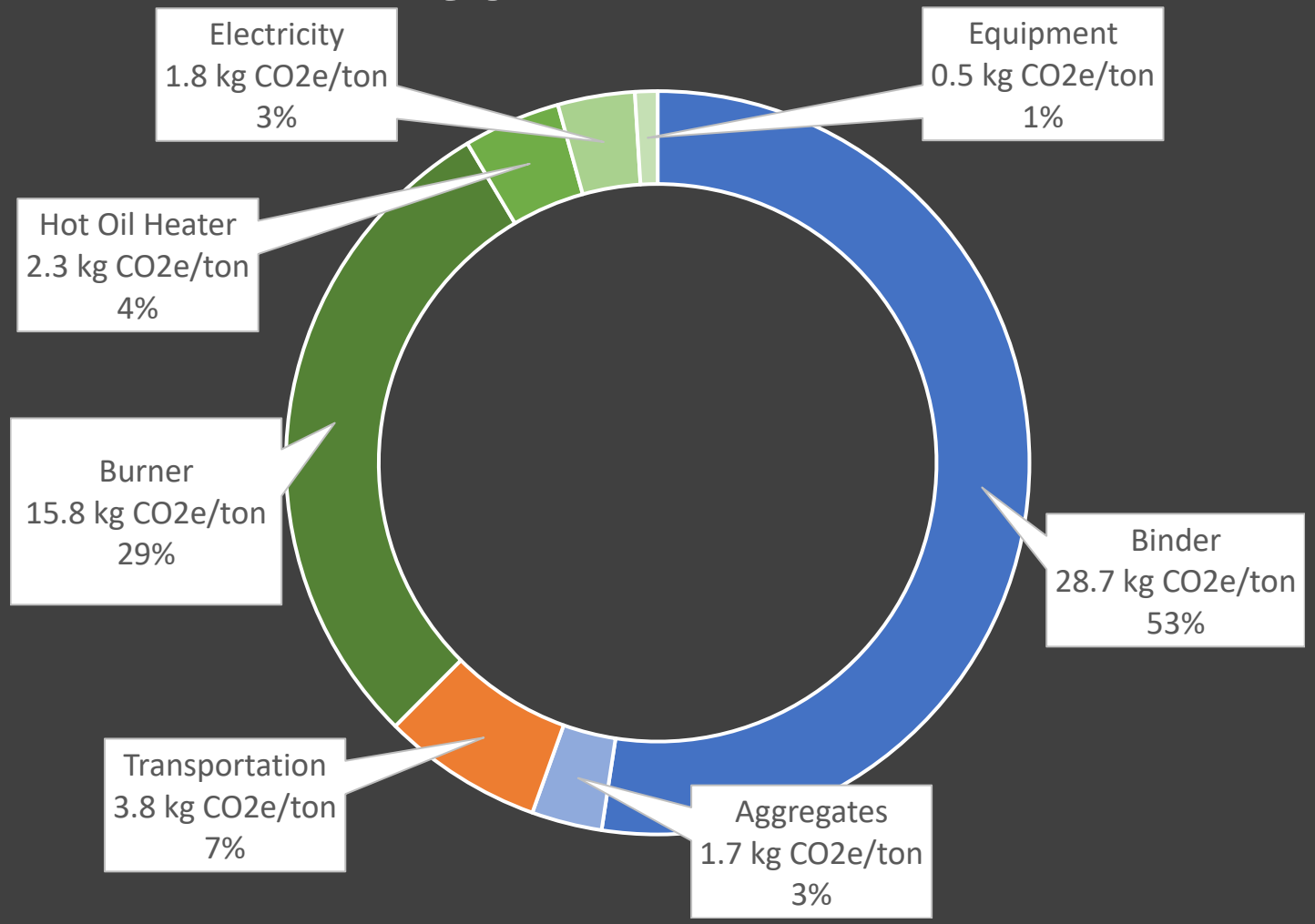
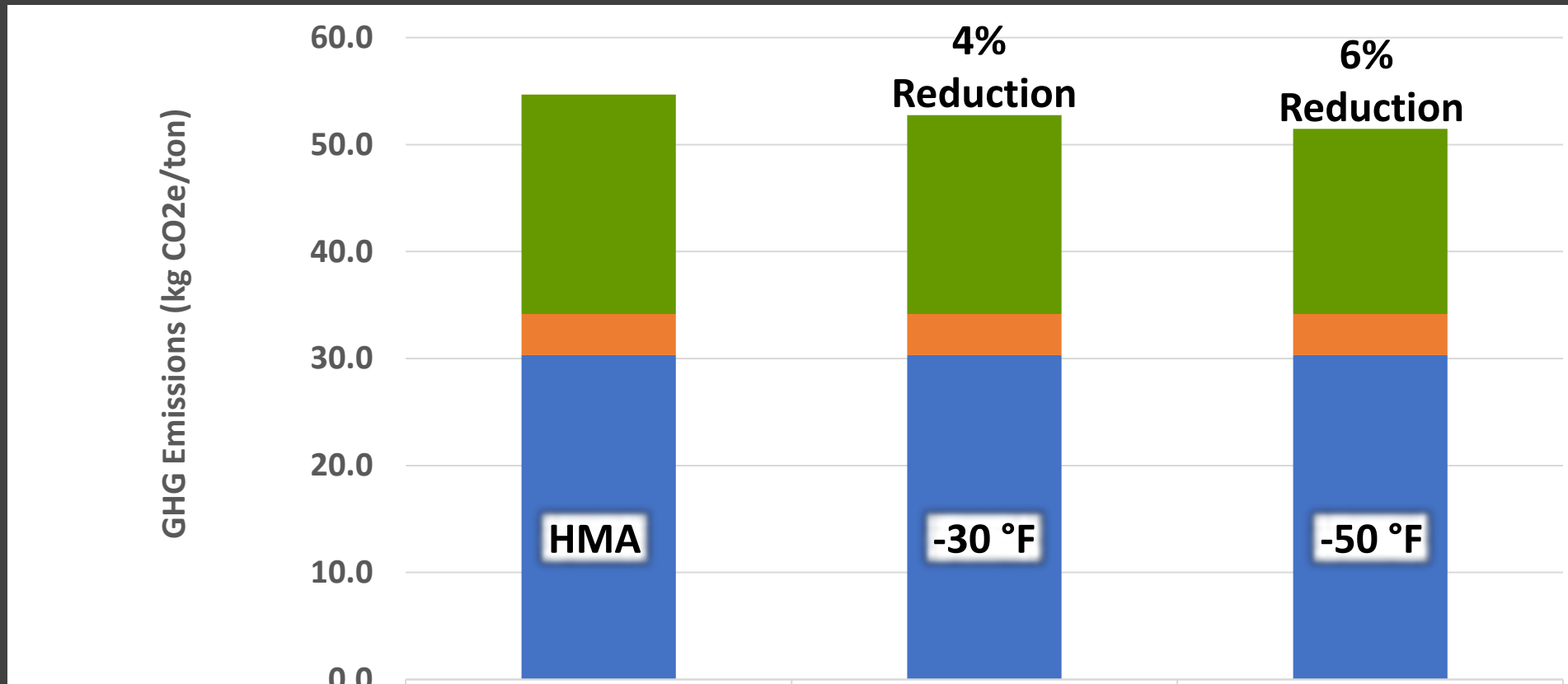



Total = **54.7 kg CO2e/ton**

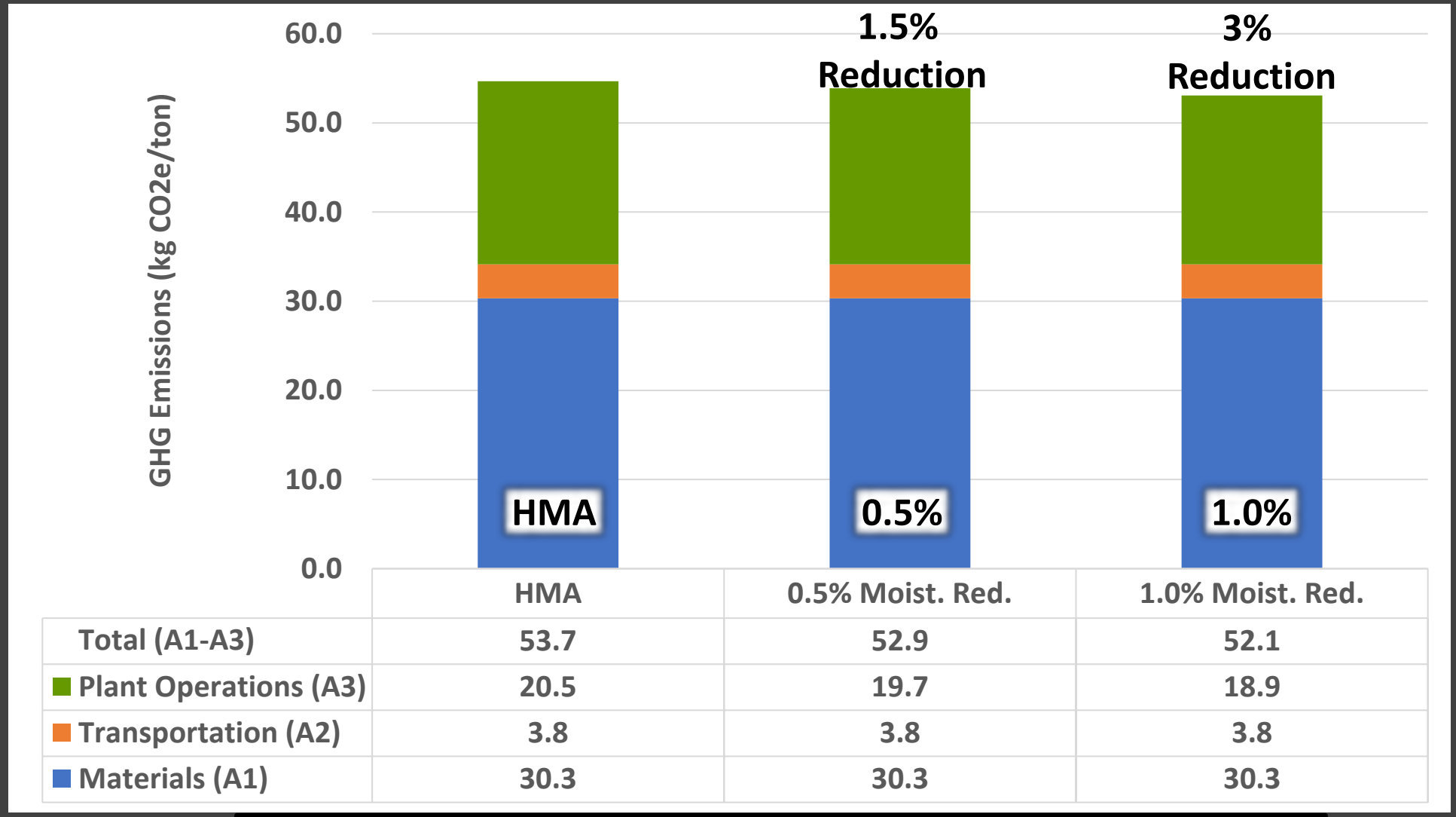
# WMA – Reduced Mix Production Temp




| | HMA | WMA -30°F | WMA -50°F |
|---|---|---|---|
| Total (A1-A3) | 53.7 | 51.8 | 50.5 |
| Plant Operations (A3) | 20.5 | 18.6 | 17.3 |
| Transportation (A2) | 3.8 | 3.8 | 3.8 |
| Materials (A1) | 30.3 | 30.3 | 30.3 |

**Assume 1,000 Btu/°F/ton fuel savings**

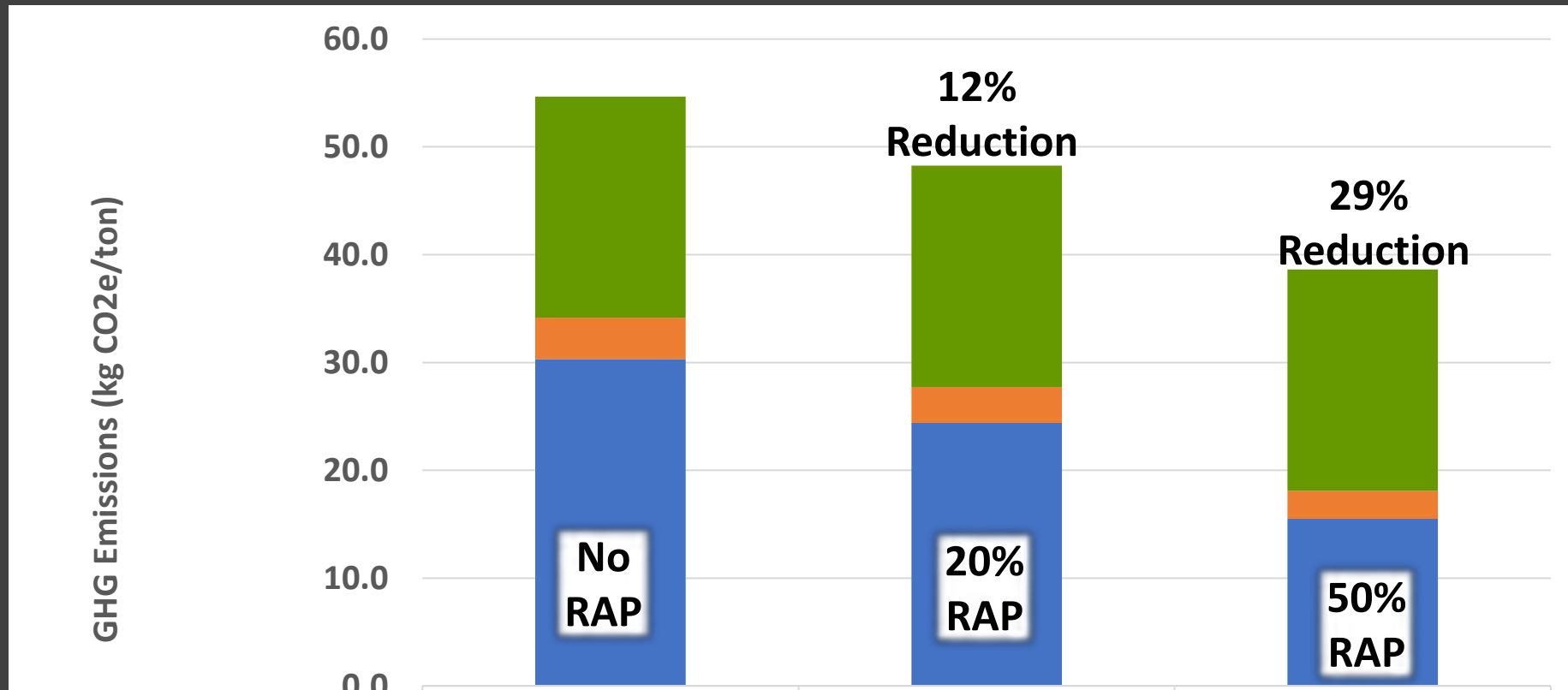
# Reduced Aggregate Moisture Content




| | HMA | 0.5% Moist. Red. | 1.0% Moist. Red. |
|---|---|---|---|
| Total (A1-A3) | 53.7 | 52.9 | 52.1 |
| Plant Operations (A3) | 20.5 | 19.7 | 18.9 |
| Transportation (A2) | 3.8 | 3.8 | 3.8 |
| Materials (A1) | 30.3 | 30.3 | 30.3 |

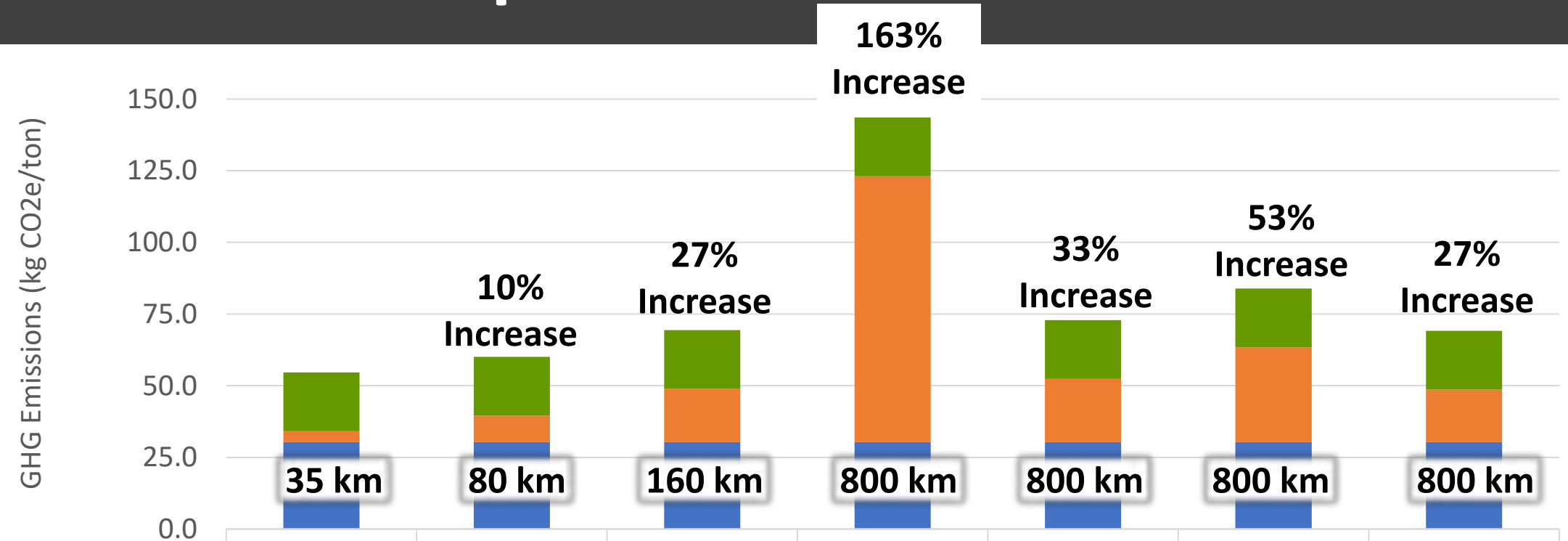
**Assume 10% Reduction in Burner Fuel Consumption per 1% Reduction in Agg. Moisture**

# Use of RAP to Reduce Emissions




| | No RAP | 20% RAP | 50% RAP |
|---|---|---|---|
| Total (A1-A3) | 54.7 | 48.2 | 38.6 |
| Plant Operations (A3) | 20.5 | 20.5 | 20.5 |
| Transportation (A2) | 3.8 | 3.3 | 2.6 |
| Materials (A1) | 30.3 | 24.4 | 15.5 |

# A2 Transport Distance and Mode




| | Average Truck | 50 Miles Truck | 100 Miles Truck | 500 Miles Truck | 500 Miles Train | 500 Miles Inland Barge | 500 Miles Ocean Vessel |
|---|---|---|---|---|---|---|---|
| Total (A1-A3) | 54.7 | 60.1 | 69.4 | 143.6 | 72.9 | 83.9 | 69.2 |
| Plant Operations (A3) | 20.5 | 20.5 | 20.5 | 20.5 | 20.5 | 20.5 | 20.5 |
| Transportation (A2) | 3.8 | 9.3 | 18.5 | 92.7 | 22.0 | 33.1 | 18.3 |
| Materials (A1) | 30.3 | 30.3 | 30.3 | 30.3 | 30.3 | 30.3 | 30.3 |

# Common Questions about EPDs

# Will low-embodied carbon asphalt mix sacrifice quality and durability?

- **Specifications are not going away!!!!**
- **Balanced Mix Design** is an excellent framework for innovation without sacrificing mix quality and performance

# 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

# 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

The Road Forward

A Vision for Net Zero Carbon Emissions for the Asphalt Pavement Industry

# GHG Emissions Inventory for Asphalt Mix Production in the United States

**Joseph Shacat**
**Director, Sustainable Pavements**
National Asphalt Pavement Association

NATIONAL ASPHALT PAVEMENT ASSOCIATION

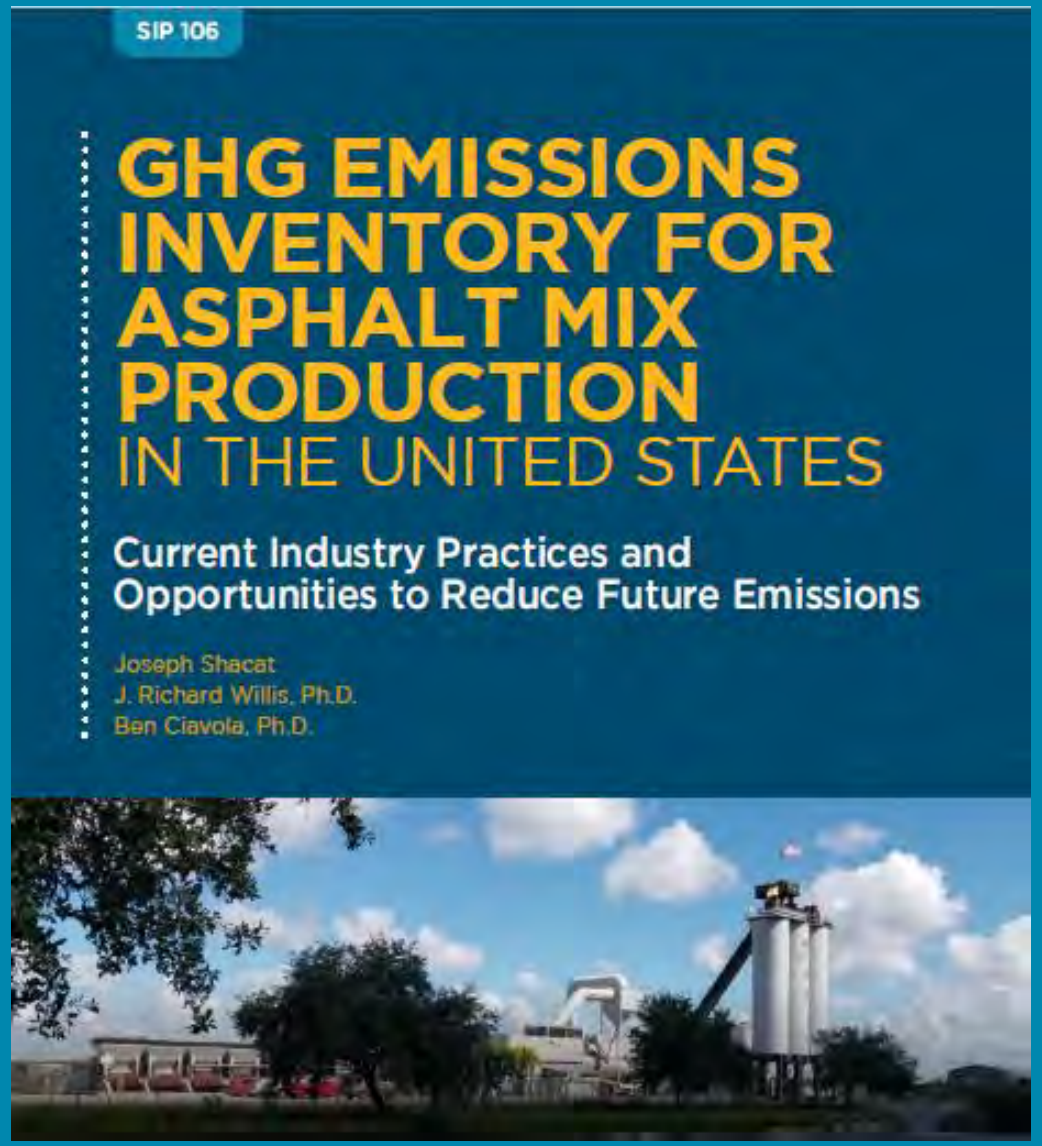
# The Report – SIP 106

- Published by NAPA in June 2022

www.asphaltpavement.org/climate

- Click on the Research link

- All references cited in this presentation are provided in the report

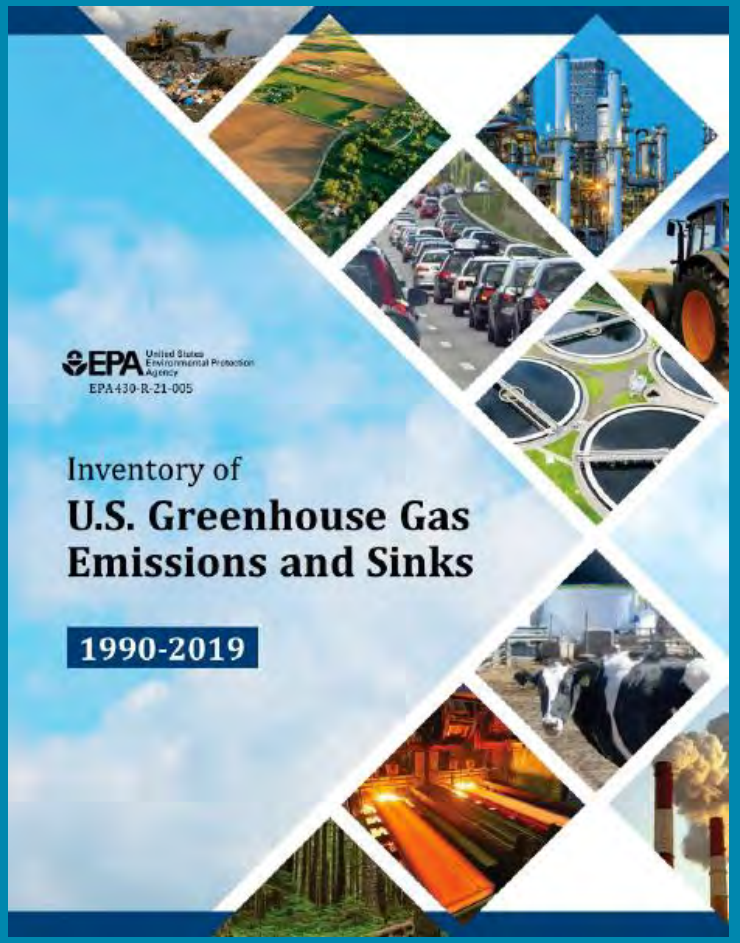


# Motivation/Goals

1. What is the U.S. asphalt paving industry's cradle-to-gate carbon footprint as a whole?
2. What are the benefits of current practices?
3. How far can we get toward net zero GHG emissions with existing technologies?

# U.S. EPA GHG Emissions Inventory

- Doesn’t the EPA report include GHG emissions for asphalt?



# U.S. EPA GHG Emissions Inventory

**Table 3-22: 2019 Adjusted Non-Energy Use Fossil Fuel Consumption, Storage, and Emissions**

| Sector/Fuel Type | Adjusted Non-Energy Use[a] (TBtu) | Carbon Content Coefficient (MMT C/QBtu) | Potential Carbon (MMT C) | Storage Factor | Carbon Stored (MMT C) | Carbon Emissions (MMT C) | Carbon Emissions (MMT $CO_2$ Eq.) |
|---|---|---|---|---|---|---|---|
| Industry | 5,492.3 | NA | 94.6 | NA | 62.1 | 32.5 | 119.2 |
| Industrial Coking Coal | 132.1 | 25.59 | 3.4 | 0.10 | 0.3 | 3.0 | 11.2 |
| Industrial Other Coal | 9.5 | 26.07 | 0.2 | 0.62 | 0.2 | 0.1 | 0.3 |
| Natural Gas to Chemical Plants | 664.6 | 14.47 | 9.6 | 0.62 | 5.9 | 3.6 | 13.4 |
| Asphalt & Road Oil | 843.9 | 20.55 | 17.3 | 1.00 | 17.3 | 0.1 | 0.3 |

- EPA Report focuses on combustion & process emissions from petroleum → asphalt binder ≈ 0

# NAPA's History of GHG Quantification for Asphalt Mixture Production

- Early 2010s – NAPA GHG Calculator
- 2017 – Emerald Eco-Label EPD Tool

} Plant Specific Focus

- 2020 – Incorporated GHG Emissions Reduction into Annual Recycled Materials and Warm Mix Technologies Survey
- 2022 – Published GHG Emissions Inventory

} Industry Wide Focus

# 1. What is the asphalt paving industry’s cradle-to-gate carbon footprint as a whole?

# Methodology

- LCA model developed by Mukherjee (2021)
- Developed a “giant” asphalt plant that produces an “average” mix design

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

*April 2022*

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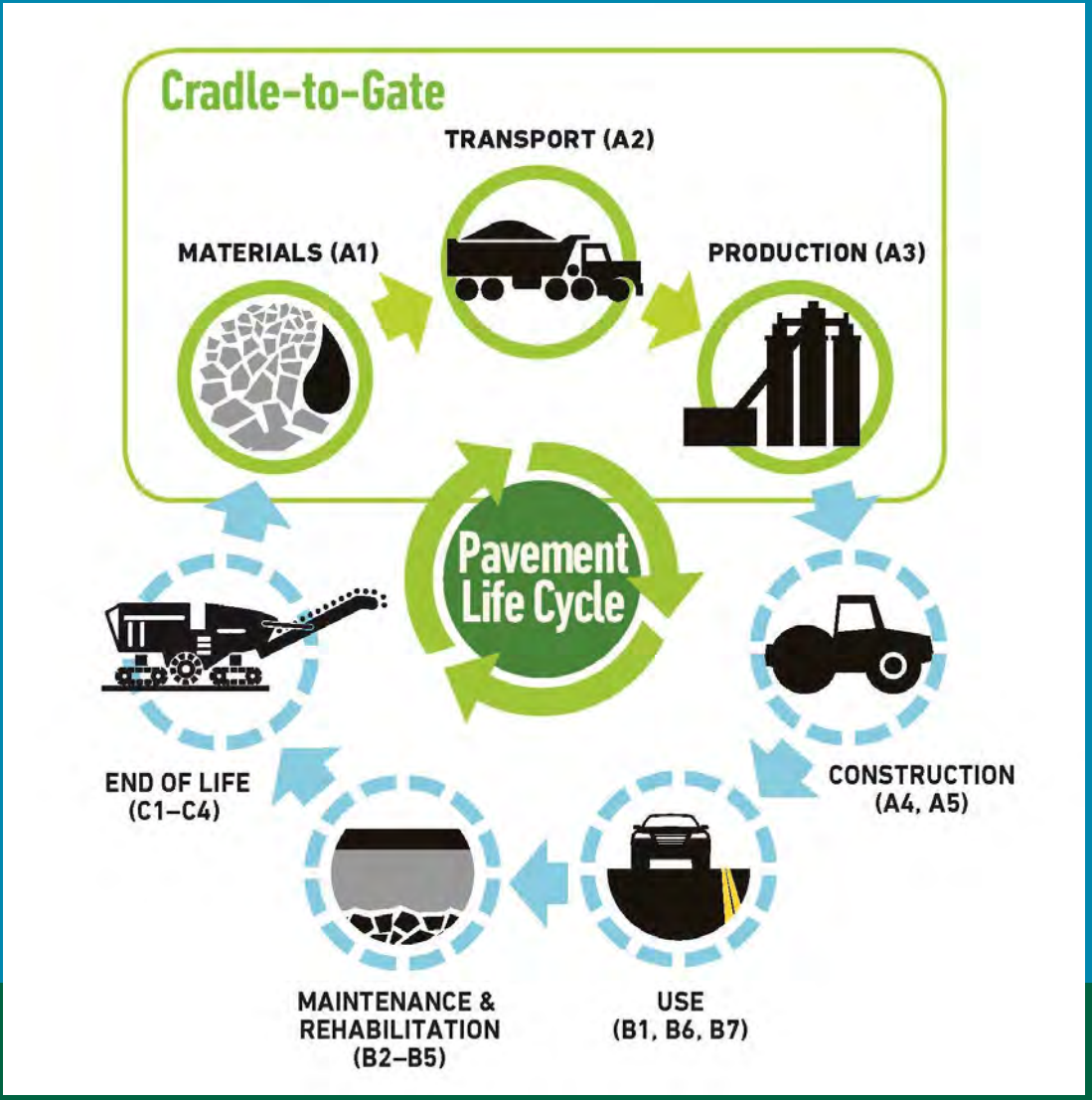
# Cradle-to-Gate Scope

- Aligns with EPDs for Asphalt Mixture
  - Materials (A1)
  - Transport (A2)
  - Production (A3)



# Data Inputs – Plant Operations (A3)

# General Approach – Plant Operations

**Total Energy Consumption**
= Energy Intensity x Total Mix Production[1]

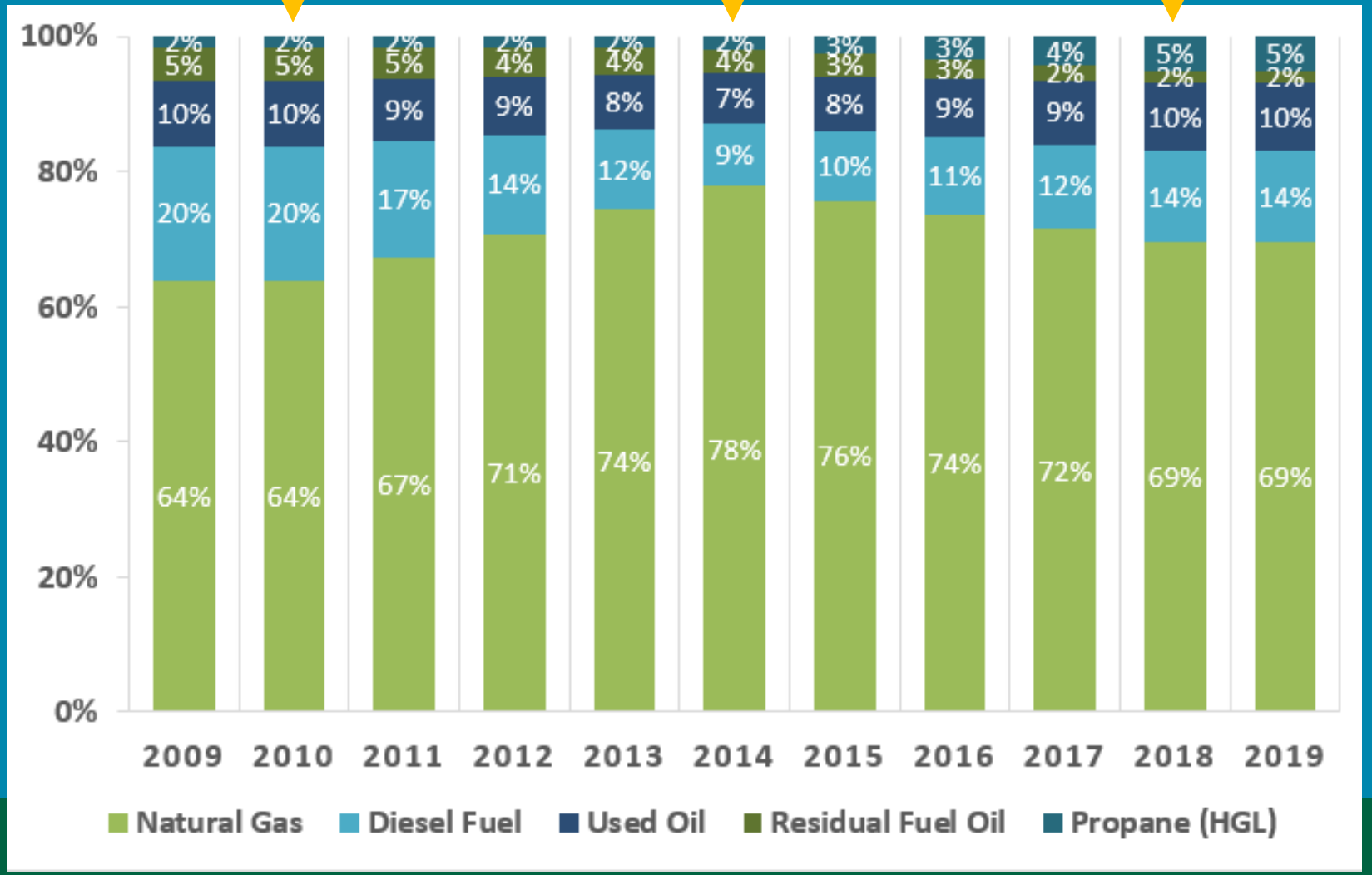
**Fuel Intensity**[2]
0.289 MMBtu/ton mix production

**Electricity Intensity**[2]
3.32 kWh/ton mix production

1. Total mix production from NAPA/FHWA Industry Surveys, 2009-2019
2. Energy intensities from Mukherjee (2016) LCA of Asphalt Mixtures

# Blend of Fuels Consumed

- Derived from U.S. EIA/Census Bureau Manufacturing Energy Consumption Survey (MECS)
- Reported every 4 years



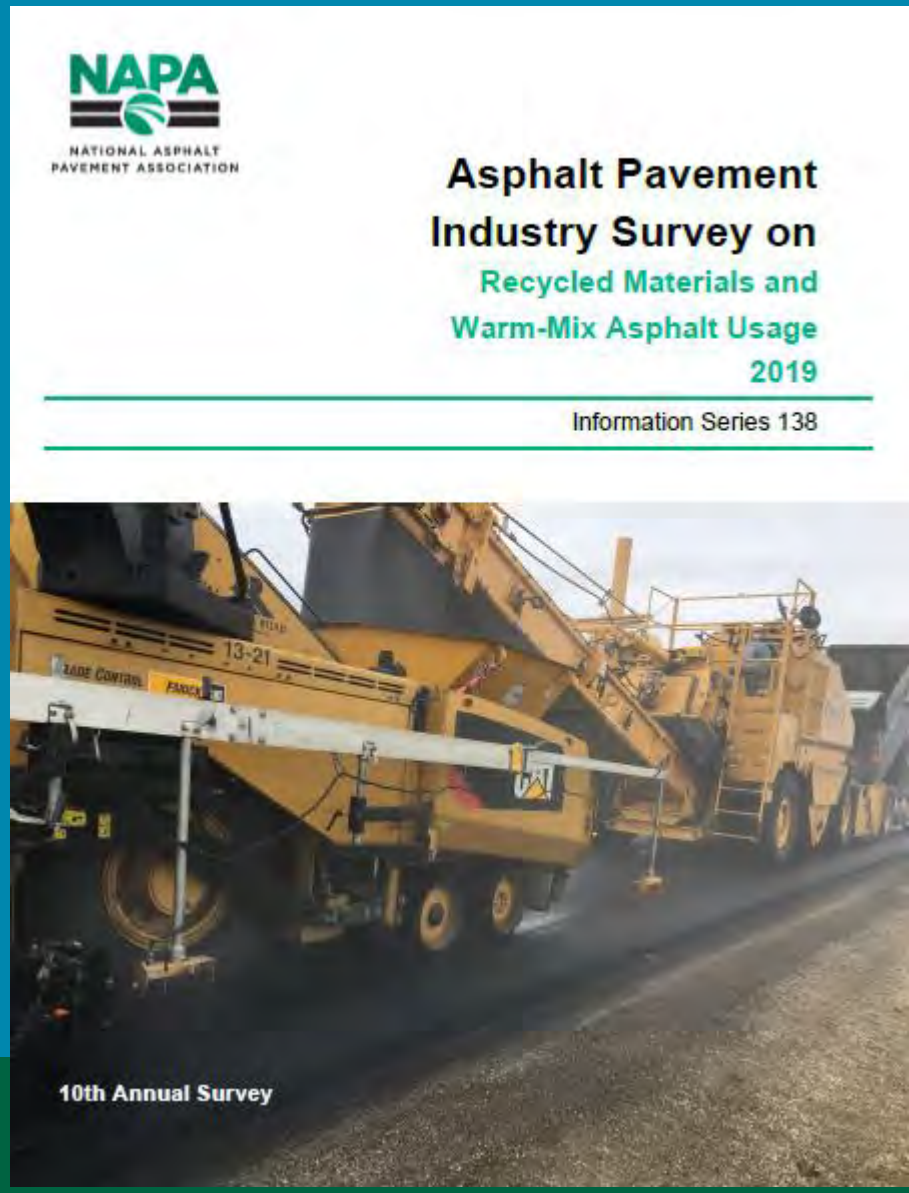
# “Average” Plant Energy Consumption

- Convert fuel consumption intensities from thermal units to physical units
- Multiply fuel consumption intensity by total annual mix production
  - Result is **total annual consumption** for each fuel type

# Data Inputs – Materials (A1)

# Average Mix Design – Recycled Materials

- Reclaimed Asphalt Pavement (RAP)
- Recycled Asphalt Shingles (RAS)
- RAP and RAS content of “average” mix based on reported use in NAPA/FHWA Industry Survey



# Average Mix Design Virgin Asphalt Binder Content

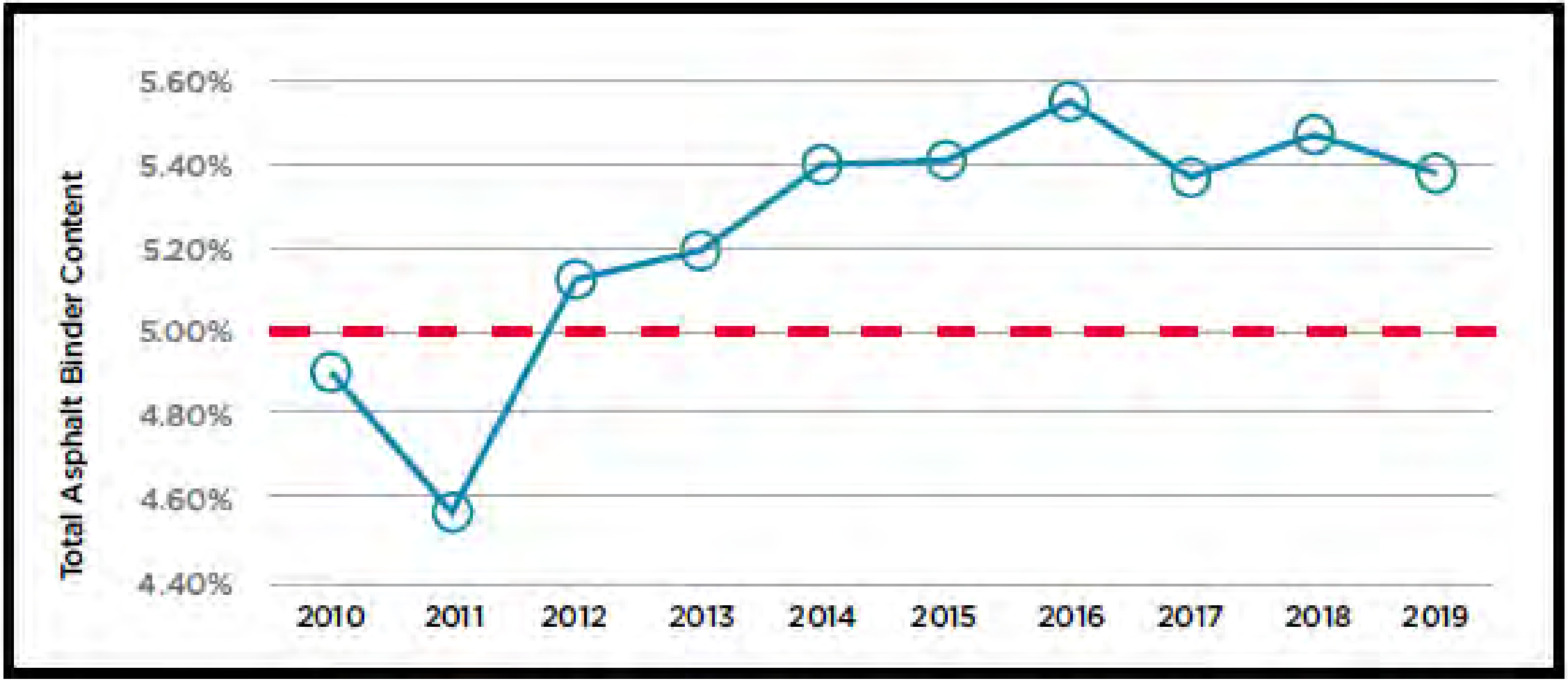
- Neat and Modified binder content based on Asphalt Institute industry survey
- Asphalt Binder data as reported, not estimated
- Reasonableness check
  - Assume total binder content >5.0%

# Average Mix Design
# Total Asphalt Binder Content

**Total Binder** = Neat + Modified + Recycled Binder

- For recycled binder, assume that:
  - RAP = 5% binder content
  - RAS = 20% binder content

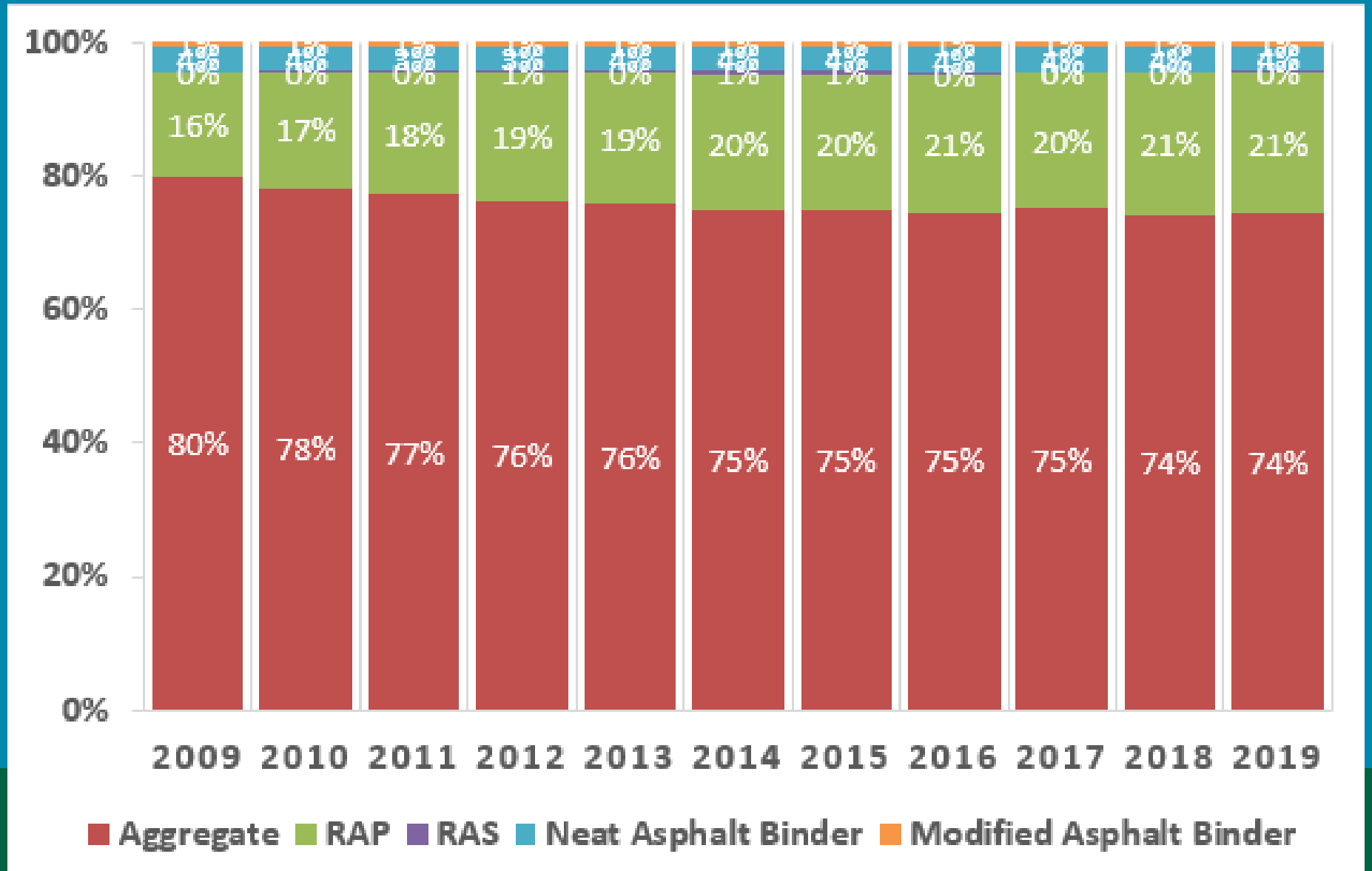
# Asphalt Binder Content Reasonableness Check



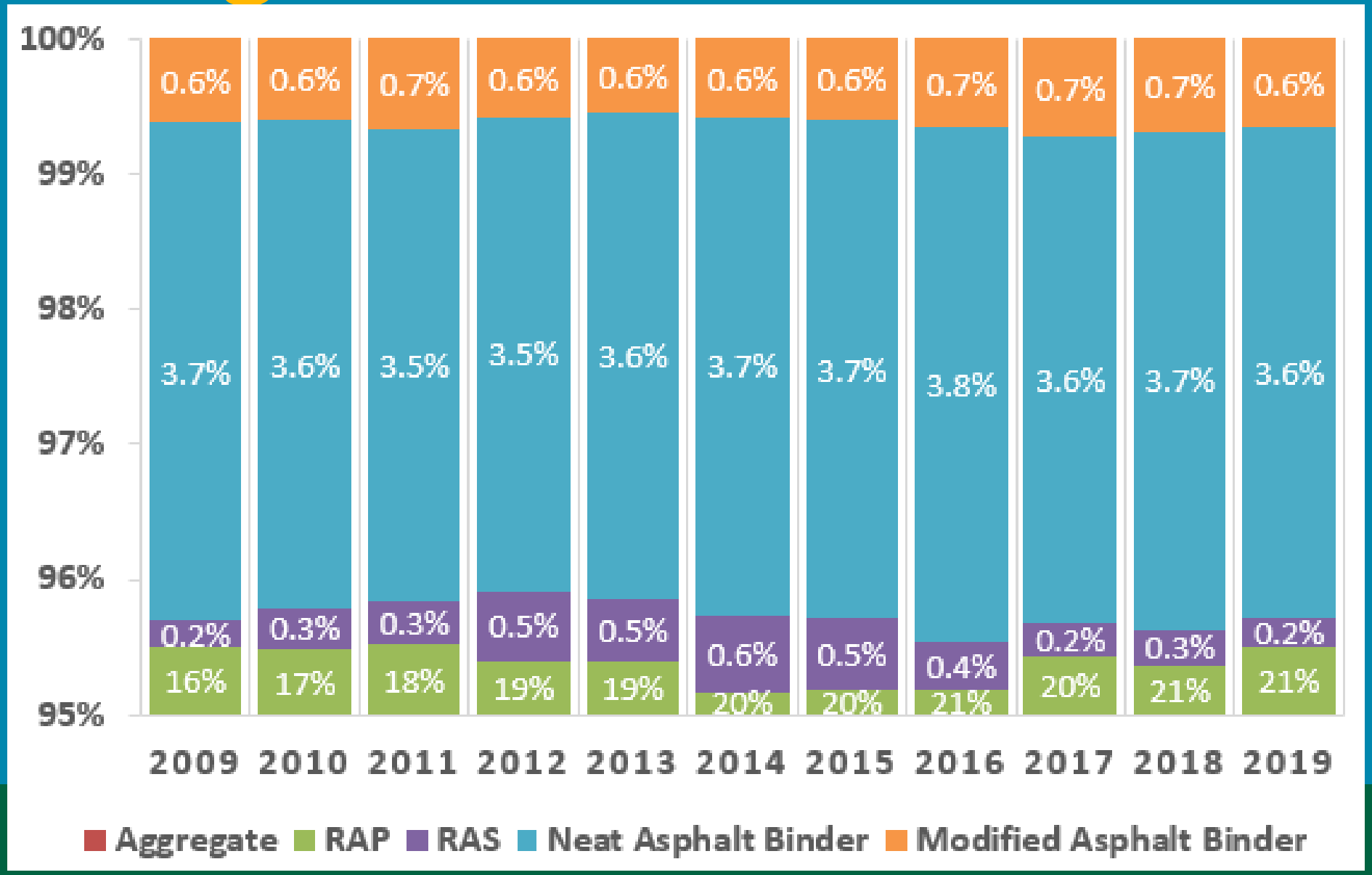
# Virgin Aggregate Content

= 100% - RAP - RAS - Neat Binder - Modified Binder

# Average Mix Content



# Average Mix Content – Last 5%



# Data Gaps for Materials

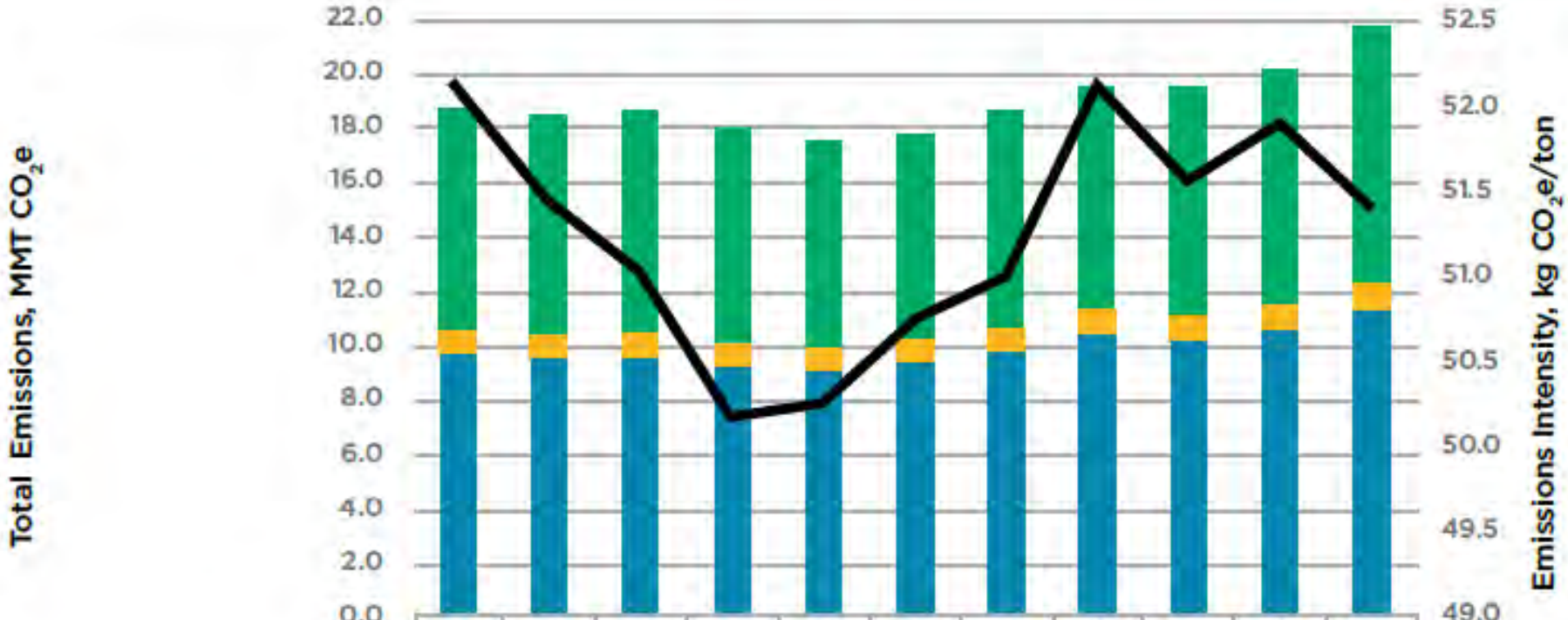
- Hydrated Lime
- Slag Aggregates
- Liquid Anti-Strip
- WMA Additives
- Fibers
- Recycling Agents
- Other Modifiers

# Data Inputs – Transportation (A2)

# Transport Distances

| Material | Distance | Units | Reference |
|---|---|---|---|
| Aggregates | 21.5 | ton-miles/ton | Mukherjee (2016) |
| Asphalt Binder | 3.9 | ton-miles/ton | Mukherjee (2016) |
| RAP - Jobsite to Processing Site (C2) | 33 | ton-miles/ton | Shacat (2021) |
| RAP - From Processing Site to Plant (A2) | 7.2 | ton-miles/ton | Shacat (2021) |
| RAS - From Processing Site to Plant (A2) | 50 | ton-miles/ton | NAPA (2017) |

# Emissions Inventory Results



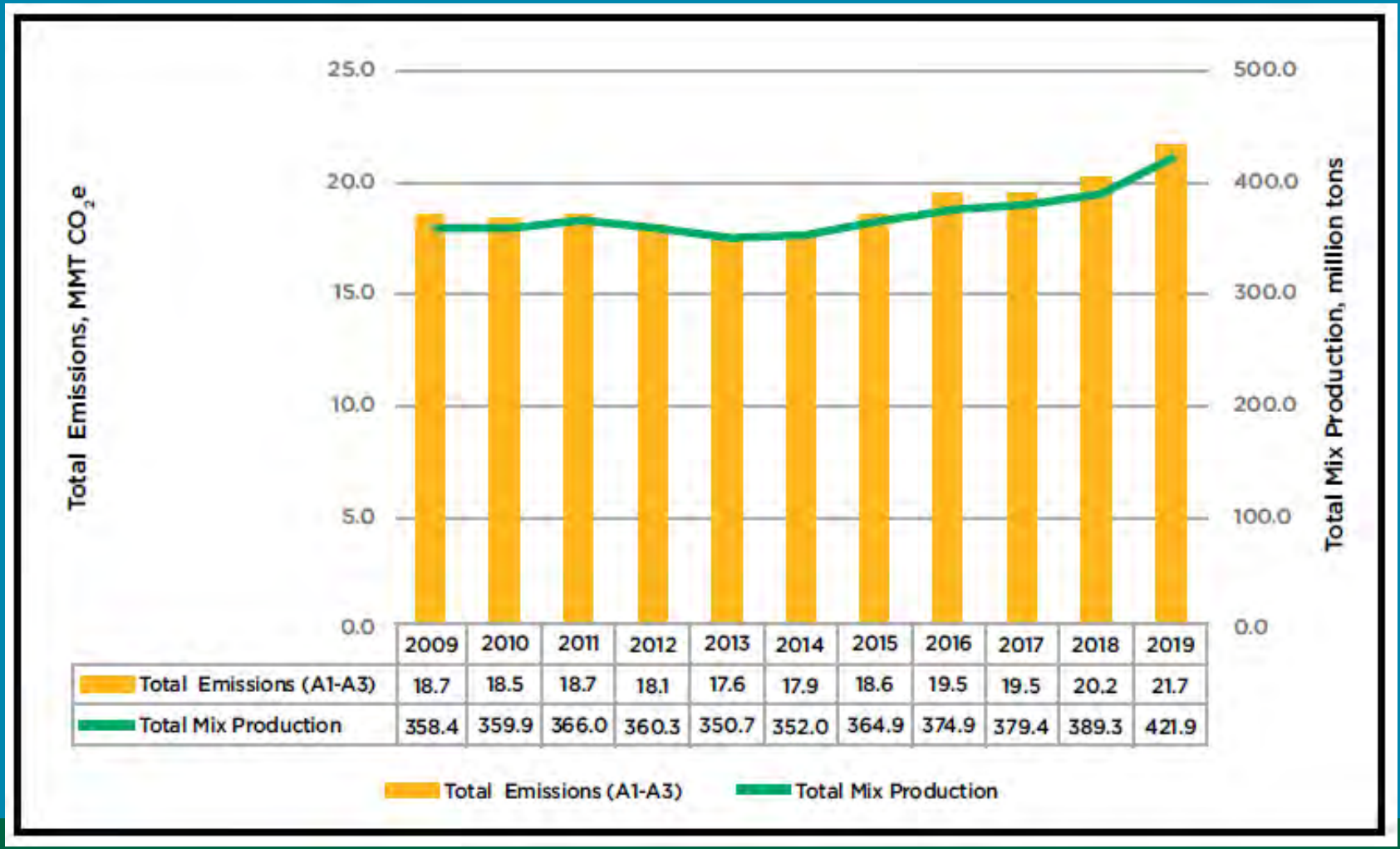

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Emissions (A1-A3) | 18.7 | 18.5 | 18.7 | 18.1 | 17.6 | 17.9 | 18.6 | 19.5 | 19.5 | 20.2 | 21.7 |
| Mix Production (A3) | 8.1 | 8.1 | 8.2 | 8.0 | 7.7 | 7.7 | 8.0 | 8.2 | 8.4 | 8.6 | 9.4 |
| Transportation (A2) | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 |
| Materials (A1) | 9.7 | 9.5 | 9.6 | 9.2 | 9.0 | 9.3 | 9.7 | 10.4 | 10.2 | 10.6 | 11.3 |
| Emissions Intensity | 52.1 | 51.4 | 51.0 | 50.2 | 50.2 | 50.7 | 51.0 | 52.1 | 51.5 | 51.9 | 51.4 |

| Parameter | Units | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RAP Accepted by Mix Producers[1] | million tons | 67.2 | 73.5 | 79.1 | 71.3 | 76.1 | 75.8 | 78.0 | 81.8 | 79.9 | 101.1 | 97.0 |
| GHG Emissions, End-of-Life RAP Transport (C2) | MMT $CO_2e$ | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 |

# Emissions Relative to Other Sectors

| Sector | 2019 Emissions, MMT $CO_2e$ | Percentage of U.S. Emissions from Each Sector, 2019 | Percentage of Emissions for Sector from Asphalt Mix Production, Cradle-to-Gate |
|---|---|---|---|
| **Total United States Emissions[1]** | **6,558.3** | | **0.3%** |
| Transportation Emissions from Fossil Fuel Combustion[2] | 1,821.9 | 27.8% | 1.2% |
| Highway Transportation Emissions from Fossil Fuel Combustion[4] | 1,481.2 | 22.6% | 1.5% |
| Industrial Emissions[3] | 1,661.5 | 25.3% | 1.3% |
| Iron and Steel Production and Metallurgical Coke Production, Process Emissions[5] | 41.3 | 0.6% | |
| Cement Production, Process Emissions[6] | 40.9 | 0.6% | |
| Asphalt Mix Production, Cradle-to-Gate[7] | 21.7 | 0.3% | |

# Total emissions have tracked with mix production




| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Emissions (A1-A3) | 18.7 | 18.5 | 18.7 | 18.1 | 17.6 | 17.9 | 18.6 | 19.5 | 19.5 | 20.2 | 21.7 |
| Total Mix Production | 358.4 | 359.9 | 366.0 | 360.3 | 350.7 | 352.0 | 364.9 | 374.9 | 379.4 | 389.3 | 421.9 |

- **Production** increased by 17.7%
- Total **GHG emissions** increased by 16%

# General Observations

- Emissions Intensity and total emissions were lowest in 2012-2015
  - Highest consumption of natural gas (2014)
  - Highest use of RAS (2014)
  - Lower use of modified binder
  - Lower total mix production
- Not enough data to see changes in energy efficiency over time

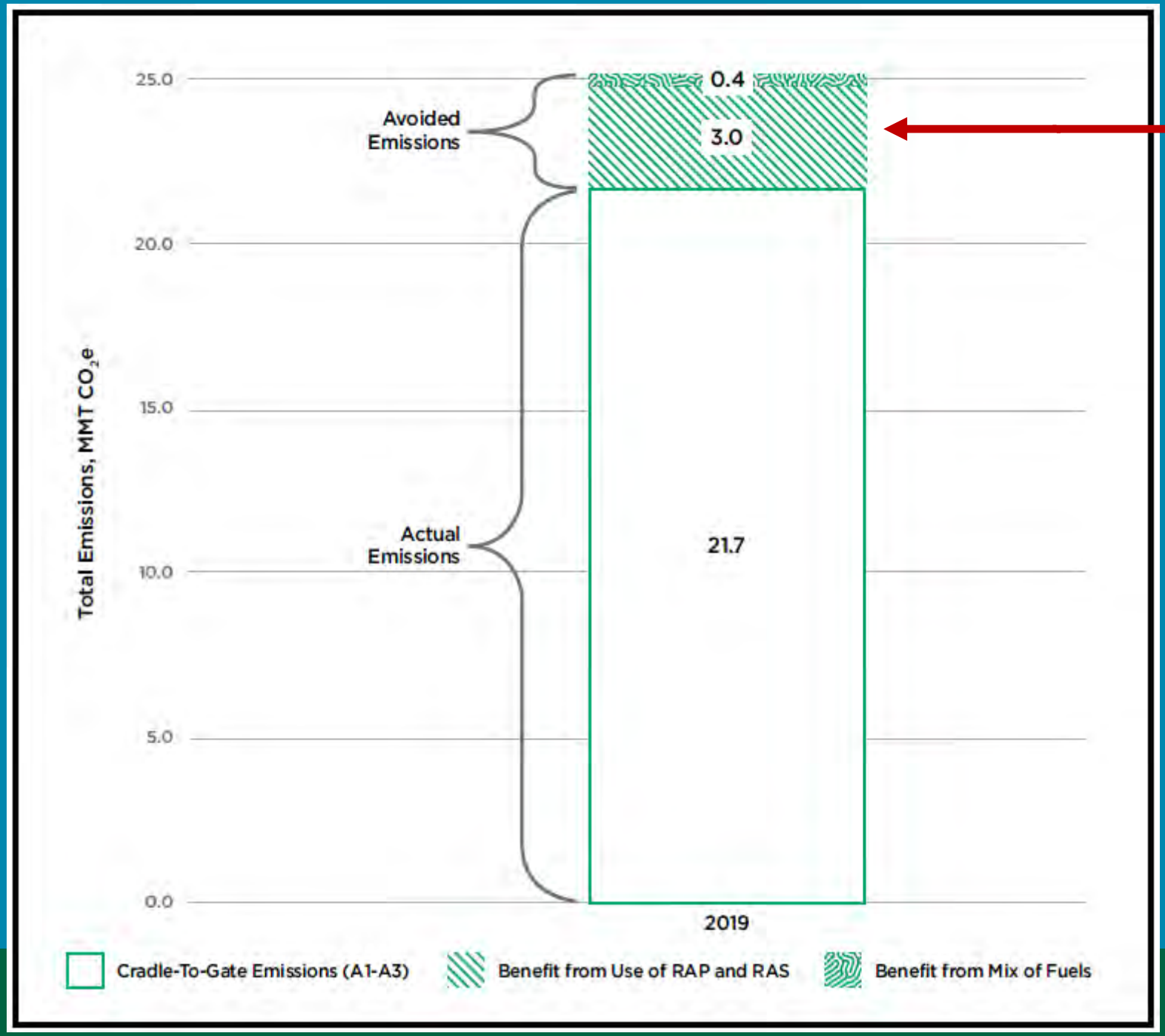
# How is the average GHG emissions intensity different from an industry average EPD?

- Only GWP is reported, no other impact indicators
- Not fully compliant with PCR for Asphalt Mixtures
- Not broken out into subcategories/products
  - Agency specifications & mix types need to be benchmarked
- **Not suitable for establishing GWP limits or other procurement policies**

# 2. What are the benefits of current industry practices?

# Scenarios to Quantify Benefits of Existing Practices (2019)

- What if no RAP or RAS were used?
- What if the industry's use of natural gas were equivalent to the industrial sector as a whole?
  - 51.7% instead of 69.5%
  - Adjust other fuels proportionately




Emissions would be 16% higher if we:

- Used no RAP or RAS, and
- Burned less natural gas

# Net Benefits of Existing Practices

- 3.4 MMT $CO_2e$ avoided emissions
- Subtract 0.5 MMT for end-of-life RAP transport
- Net result is 2.9 MMT $CO_2e$ avoided emissions
- Equivalent to 630,000 passenger vehicles


https://www.wired.com/story/california-nope-epa-car-emissions/

# Benefits of Using More RAP

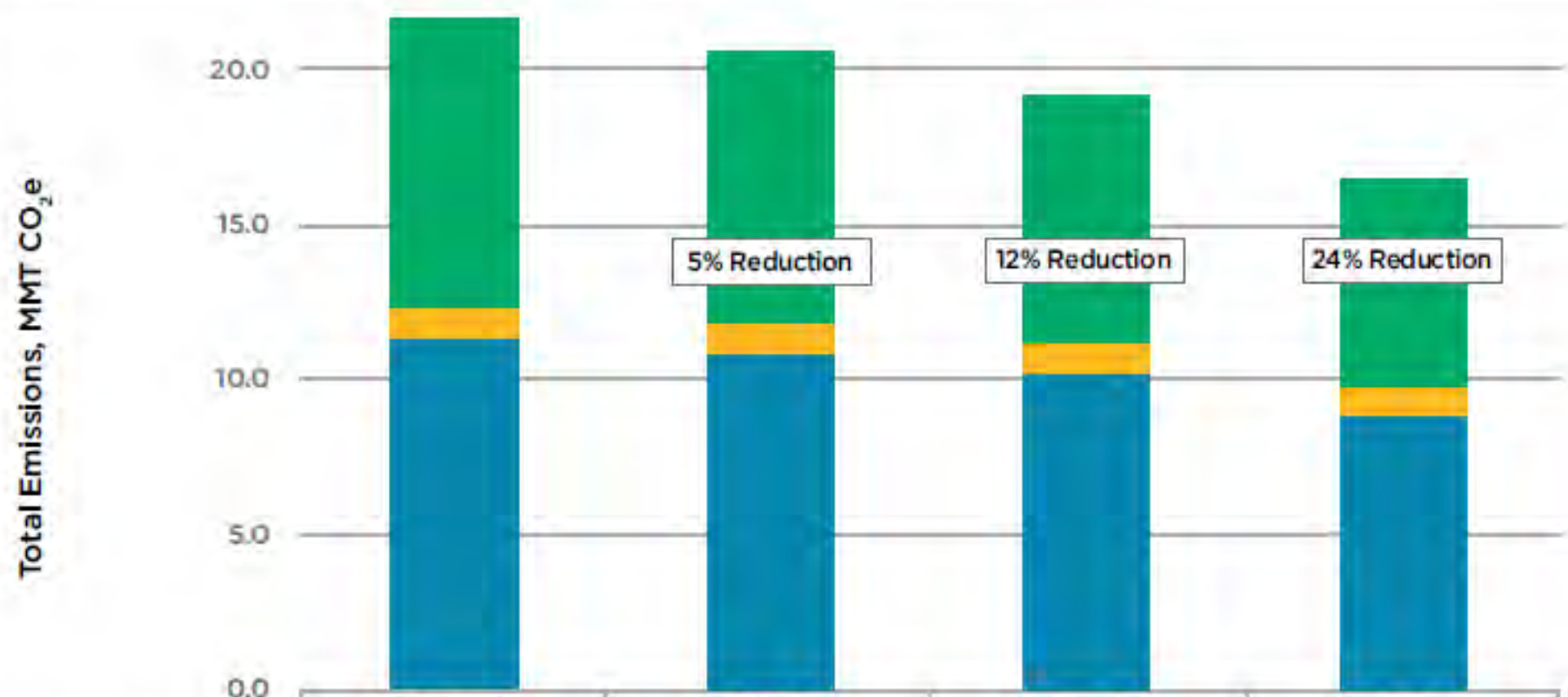
Nationwide, increasing the amount of RAP in new asphalt mixtures by one percentage point (e.g., from 21.1% to 22.1%) would result in 0.14 MMT $CO_2e$ in avoided emissions, equivalent to approximately 30,000 passenger vehicles assuming typical passenger vehicle emissions of 4.6 tonne $CO_2e$ per year (U.S. EPA, 2018).

# 3. How far can we get toward net zero GHG emissions with existing technologies?

# 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 |

# General Observations

- The good news:
  - We can reduce GHG emissions (relative to 2019) by 24% with existing technologies and practices!
- Challenges to achieving GHG reductions:
  - Policy & Economic Headwinds
- Opportunities to address challenges
  - Inflation Reduction Act (IRA), others

# Policy Headwinds – Use of RAP

- Mix specifications that limit RAP use
  - Need to revise hundreds (thousands?) of agency specifications
  - Slow process due to conservative, risk-averse approach
  - Balanced Mix Design (BMD) offers an opportunity to accelerate innovation

- Some agencies retain ownership of RAP
  - Not the highest and best use
  - Consider allowing contractor to retain ownership and recycle into new mixes

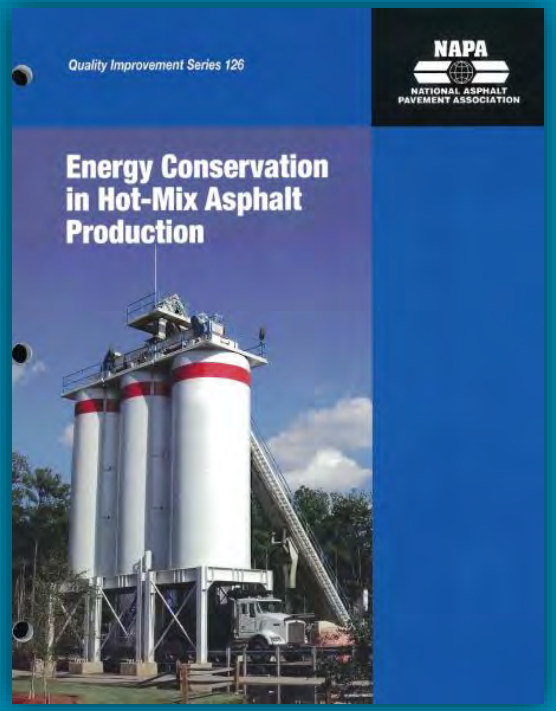
# Economic Headwinds

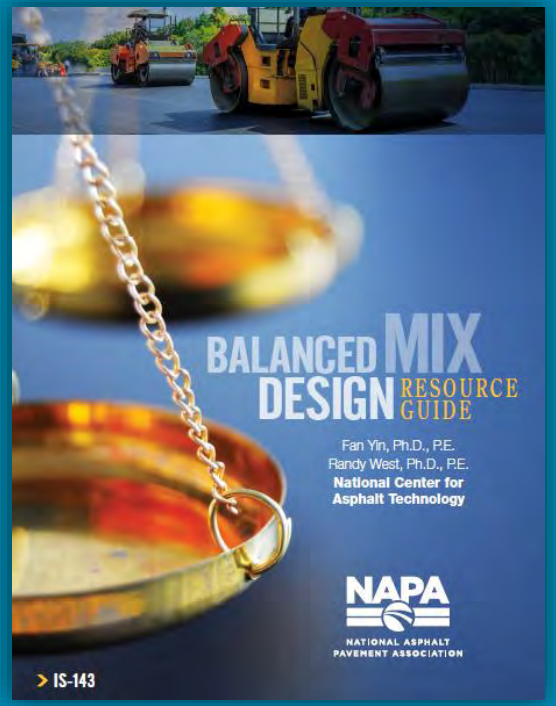
**Low bid environment**

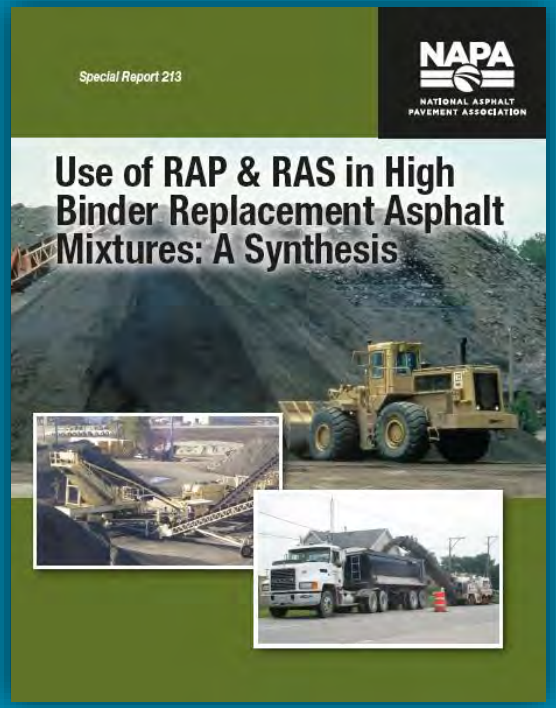
- High capital costs
  - Covering aggregate stockpiles
  - Plant upgrades for higher RAP
- Higher operating costs for some solutions
  - Alternative fuels at remote locations)
- Balancing risk and reward
  - Fuel savings for reduced mix production temperature vs. achieving density requirements/incentives

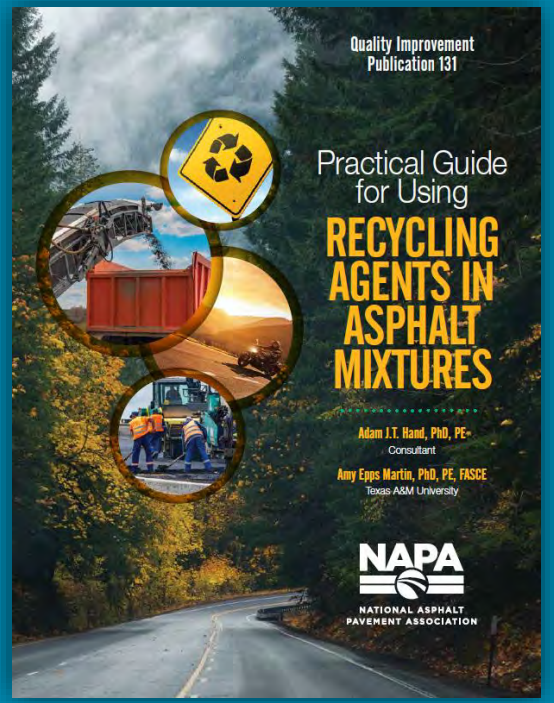
# NAPA Resources to Help Reduce Emissions

# NAPA Publications



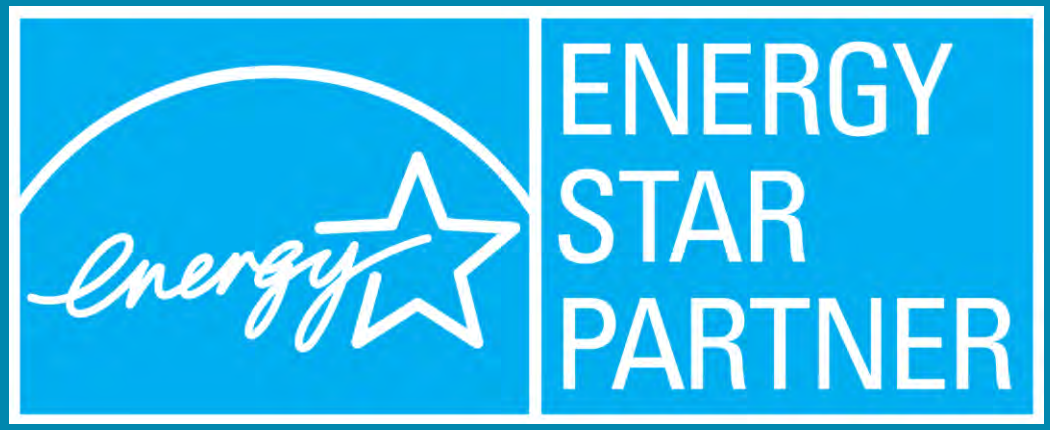




## Readily Implementable Technologies Web Resource:

https://www.asphaltpavement.org/climate/research-best-practices/implementable-technologies

# Asphalt Plant Energy Performance Peer Exchange (APEX)




- Partner with U.S. EPA
- Market and promote your company's partnership
- Learn best practices to manage energy
- Get assistance from an experienced industrial energy advisor

https://www.asphaltpavement.org/expertise/sustainability/tools/energy-star-apex-program

# Thank you, Pennsylvania!

# ENERGY STAR INDUSTRIAL PROGRAM

- No cost to participate
- Guidelines and tools time-tested by hundreds of companies
- A national peer network of industrial energy managers
- Recognition and goal-setting programs
- Sector-specific guides and peer groups

# OVERVIEW

## Why Manage Energy?

**1. Make A Commitment**

- Industrial Partnership
- APEX Peer Exchange Group

**2. Assess Performance & Set A Goal**

- Challenge for Industry
- Energy Performance Indicator

**3. Look for Energy-Saving Opportunities**

- Energy Treasure Hunts
- Energy Guide for Asphalt Plants

# Why Manage Energy?

- Energy costs for asphalt paving are significant.
  - 7-10% of total operating costs
- Energy costs are controllable.
  - Reduce energy intensity by 20% in 2 years
- Assistance is available through ENERGY STAR.

*Manage energy with the same expertise used to manage other parts of your business.*

# 1. Make A Commitment

**Put Someone In Charge of Energy!**

- Go-to person for all issues
- Builds awareness with employees
- Sets goals, coordinates efforts
- Measures and tracks energy performance
- Reports progress and successes

# 1. Make A Commitment


**Become An ENERGY STAR Partner**

- www.energystar.gov/join
- Get company leadership invested
- Join a national network of industrial energy managers
- Gain access to Strategic Industrial Energy Advisor
- Use ENERGY STAR partnership logo
- Gain recognition

# 1. Make A Commitment

**Set up an introductory meeting with Kurt Schwalbe, Strategic Industrial Energy Advisor for ENERGY STAR**

- Go over how to become an Industrial Partner
- Learn about what support Kurt can provide
- Email Katie Healy to schedule a call:
  - healy.kathleen@epa.gov

# 1. Make A Commitment

## Join the *Asphalt Plant Energy Performance Peer Exchange* (APEX)


- ENERGY STAR & NAPA initiative
- Share best practices and challenges
- Prepare for future "low carbon" requirements
- Expectations:
  - Participate in APEX meetings
  - View 2 recorded webinars
  - Register at least one plant for the **Challenge for Industry**
  - Become an ENERGY STAR **Industrial Partner**

# 2. Assess Performance & Set A Goal

**Get Started Tracking Energy!**

If you have system, use it. It's OK to start simple.

***APEX Key Lesson***: *Track fuel usage and amount used per ton asphalt daily and weekly.*

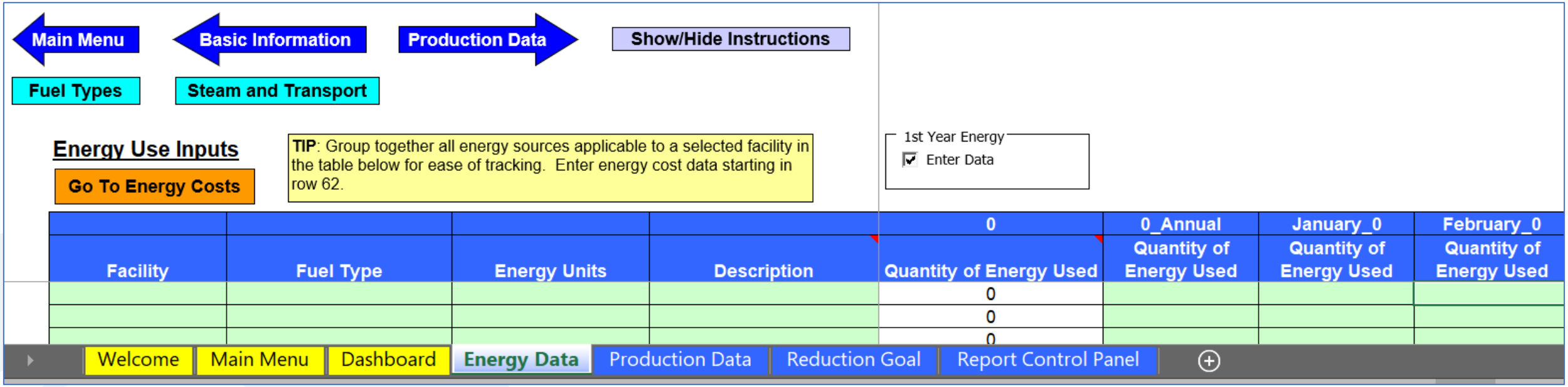
**OR**

Try the **ENERGY STAR** Energy Tracking Tool if you do not have an existing system.

# 2. Assess Performance & Set A Goal

## ENERGY STAR Energy Tracking Tool

- Spreadsheet-based tool for tracking energy over time and progress




Download the tool at:
https://www.energystar.gov/industrial_plants/industrial-energy-management-information-center

# 2. Assess Performance & Set A Goal

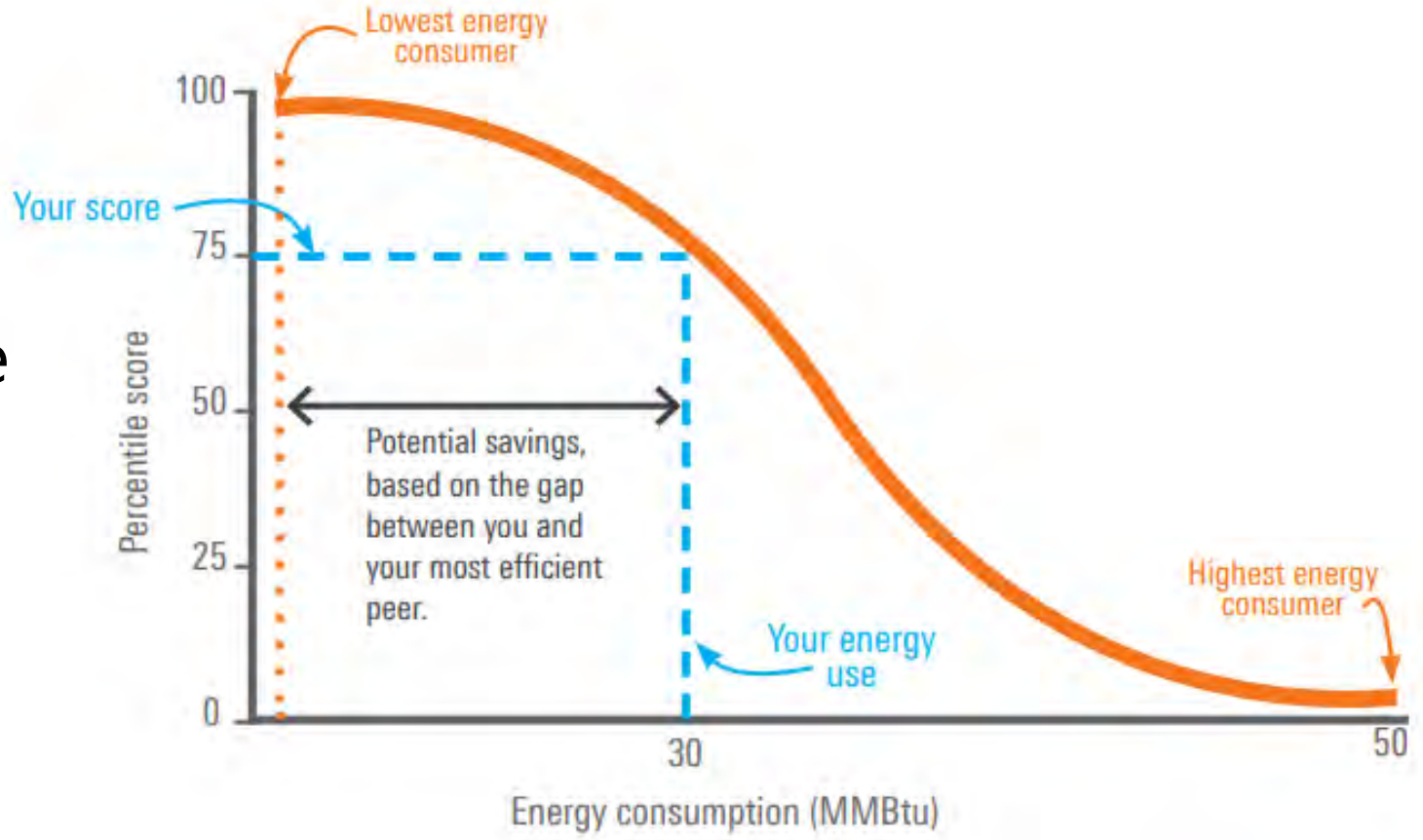

**Take the Challenge for Industry**

- Goal: Reduce energy intensity by 10% in 5 years or less
- EPA recognizes challenge achievers with certificate, logo, and letter to CEO.
- KEY LESSONS:
  - **Establishing an energy baseline at each plant enables comparison**
  - **Enroll multiple plants to create friendly competition**
- www.energystar.gov/industrychallenge

# 2. Assess Performance & Set A Goal

## Energy Performance Indicator (EPI)

- Compares your plant's energy performance to similar plants nationwide
- Generates an ENERGY STAR score on a scale of 1 to 100
- Currently under development for asphalt plants



# 3. Look for Energy-Saving Opportunities


## Energy Treasure Hunts

Focus first on no- and low-cost quick hits.

Plant walk-through:

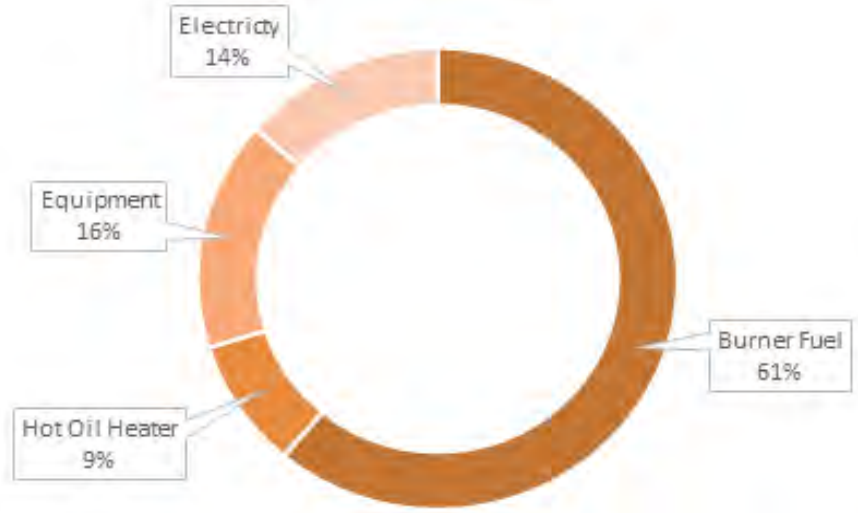
- Identify equipment that can be shut down when not needed.
  - Ex: Avoid day lighting at facilities
- Identify behavioral adjustments.
  - Ex. Shape of aggregate pile and loading operators
- Identify maintenance issues that affect energy.
  - Ex. Plan/schedule for tuning burners

KEY LESSON:

- **Involve employees in Treasure Hunts and ask them for ideas.**

# 3. Look for Energy-Saving Opportunities

Energy cost breakdown in a typical asphalt mixture production plant




**Did you know?**

Up to 95% of a motor's costs come from the energy consumed over its lifetime, while only about 5% of a motor's costs come from its purchase, installation, and maintenance (MDM 2007).

**Spotting uneven veiling**

Burned paint on one side of the exhaust gas housing's exterior often indicates excessive heat loss on the downward side of the drum rotation caused by inadequate flighting. Check metal surface temperatures in a horizontal line across the upper area of the dryer intake breeching to identify and address temperature variations.

## Energy Guide for Asphalt Mixture Production

- Developed using industry input
- Draft is currently under review and will be released soon

# 3. Look for Energy-Saving Opportunities

## Check for Utility Incentive Programs

- Utilities often offer energy use assessments or provide support for efficiency projects
- N.C. State University's Clean Energy Technology Center has compiled a database on incentives and policies across the U.S.
  - https://www.dsireusa.org

# REVIEW

- **Why Manage Energy?**
  - Energy costs are controllable! Savings go directly to your bottom line.

1. **Make A Commitment**
   - Put someone in charge of energy.
2. **Assess Performance & Set A Goal**
   - Start tracking energy and take the Challenge for Industry.
3. **Look for Energy-Saving Opportunities**
   - Focus on no- or low-cost energy savings first.

# GET INVOLVED!

- **Join APEX!** To be added to the group, email:
  - Joseph Shacat / jshacat@asphaltpavement.org
  - Katie Healy / healy.kathleen@epa.gov
- **Become an Industrial Partner!** Set up a no-commitment introductory meeting with Kurt Schwalbe (Strategic Industrial Energy Advisor) by emailing Katie:
  - Katie Healy / healy.kathleen@epa.gov
- Stay tuned for the **Energy Guide for Asphalt Mix Production**.