Asphalt Pavement Carbon Footprint Reduction Workshop

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FHWA is the source for all images unless otherwise noted.

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Abbreviations & Acronyms

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- AASHTO – American Association of State Highway and Transportation Officials
- Caltrans – California Department of Transportation
- CDOT – Colorado Department of Transportation
- EPD – Environmental Product Declaration
- FHWA – Federal Highway Administration
- GSA - General Services Administration
- HMA – Hot Mix Asphalt
- INDOT – Indiana Department of Transportation
- LCA – Life Cycle Assessment
- LCTM – Low Carbon Transportation Materials
- NAPA - National Asphalt Pavement Association
- NCHRP - National Cooperative Highway Research Program
- ODOT – Oregon DOT
- PCR – Product Category Rules
- RAP - Reclaimed Asphalt Pavement
- RAS - Recycled Asphalt Shingles
- SPTWG – Sustainable Pavements Technical Working Group
- TRB-Transportation Research Board
- WMA – Warm Mix Asphalt

Outline

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- Introduction & Background
- Objectives & Intended Outcomes
- Workshop Organization & Observations
- Post-Workshop Survey/Rankings
- TechBrief
- Summary


WOLF PACK NEVADA

TechBrief

WRSC-TB-23-02
July 2023

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This Technical Brief summarizes information obtained through a workshop held to identify techniques for reducing asphalt pavement carbon footprint, as well as short- and long-term priorities to implement the techniques identified.

Introduction

Like other industries, the asphalt industry is seeking and implementing techniques to reduce its overall carbon footprint. The U.S. government launched the Federal Sustainability Plan in December 2021 with goals of reducing Federal Operations emissions 65 percent by 2030 and achieving Net-Zero Emissions by 2050 (1). In February 2022, the National Asphalt Pavement Association (NAPA) issued The Road Forward, its vision on sustainability with a net-zero carbon emissions goal by 2050 as well (2).

For more than a decade the Federal Highway Administration (FHWA) Sustainable Pavements Technical Working Group (SPTWG) has been supporting development of resources and tools that State Departments of Transportation (DOTs) can use to help reduce the carbon footprint of their pavements and quantify the environmental impacts of

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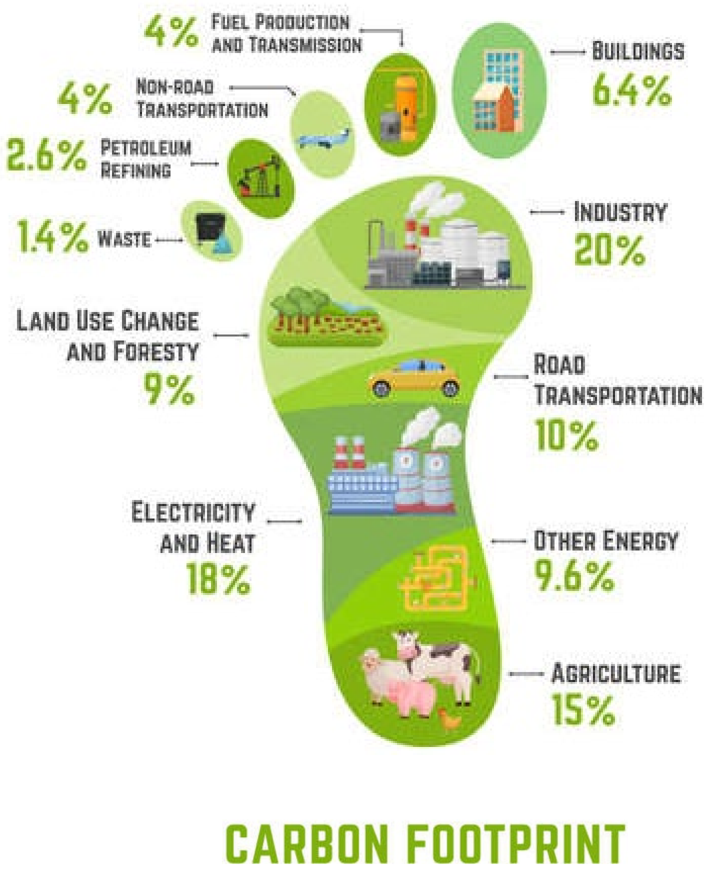
Introduction & Background

- Leading up to the Workshop Fall 2022…
- Federal Sustainability Plan December 2021
  - Reduce Federal Operations emissions 65% by 2030 & achieving Net-Zero Emissions by 2050
- NAPA *The Road Forward February 2022*
  - Vision on sustainability with net-zero carbon emissions goal by 2050

- FHWA Sustainable Pavements Technical Working Group (SPTWG)
  - Supporting development of resources & tools for DOT use to reduce the carbon footprint of pavements & quantify environmental impacts of pavement construction via LCA
- EPD's a tool to identify materials with lower carbon footprint desired by Buy Clean Acts, such as those passed in California and Colorado in 2021
- Caltrans & CDOT began to collect EPDs for construction materials procurement ***Information Only***
- 2022 Transportation Research Board (TRB) annual meeting
  - *Use of Life Cycle Assessment in Public Procurement: State of Practice*
- The U.S. General Services Administration (GSA) issued new asphalt and concrete standards for GSA construction, modernization, and paving projects

Common Goals Aligning…

What is Carbon Footprint



https://seven.edu.vn/carbon-footprint-drawing-kz8ncvne/

https://www.geeksforgeeks.org/what-is-carbon-footprint/

Workshop Objectives & Intended Outcomes

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- Organize, document and communicate techniques to reduce asphalt pavement carbon footprint identified in a workshop
- Forum for Stakeholders (State DOTs, FHWA, Asphalt Binder Producers, Asphalt Plant Manufacturers, Paving Equipment Manufacturers, and Asphalt Mixture Producers and Contractors) to Share:
  - Current Practices Implemented (at the time)
  - Short-term Strategies to Reduce GHG (0-2 years)
  - Long-term Strategies to Reduce GHG (3-5 years)
- Summarize & Rank S-T and L-T Strategies
- Develop TechBrief to Communicate Outcomes
- Deliver Webinar Summarizing Outcomes

Deliverables

- TechBrief
  - Asphalt Pavement Carbon Footprint Reduction Workshop
  - https://scholarworks.unr.edu/handle/11714/10793
- Webinar
  - https://www.unr.edu/wrsc/tools/asphalt/webinars
  - 16 Others and 3 Q1-2024

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Workshop Participants

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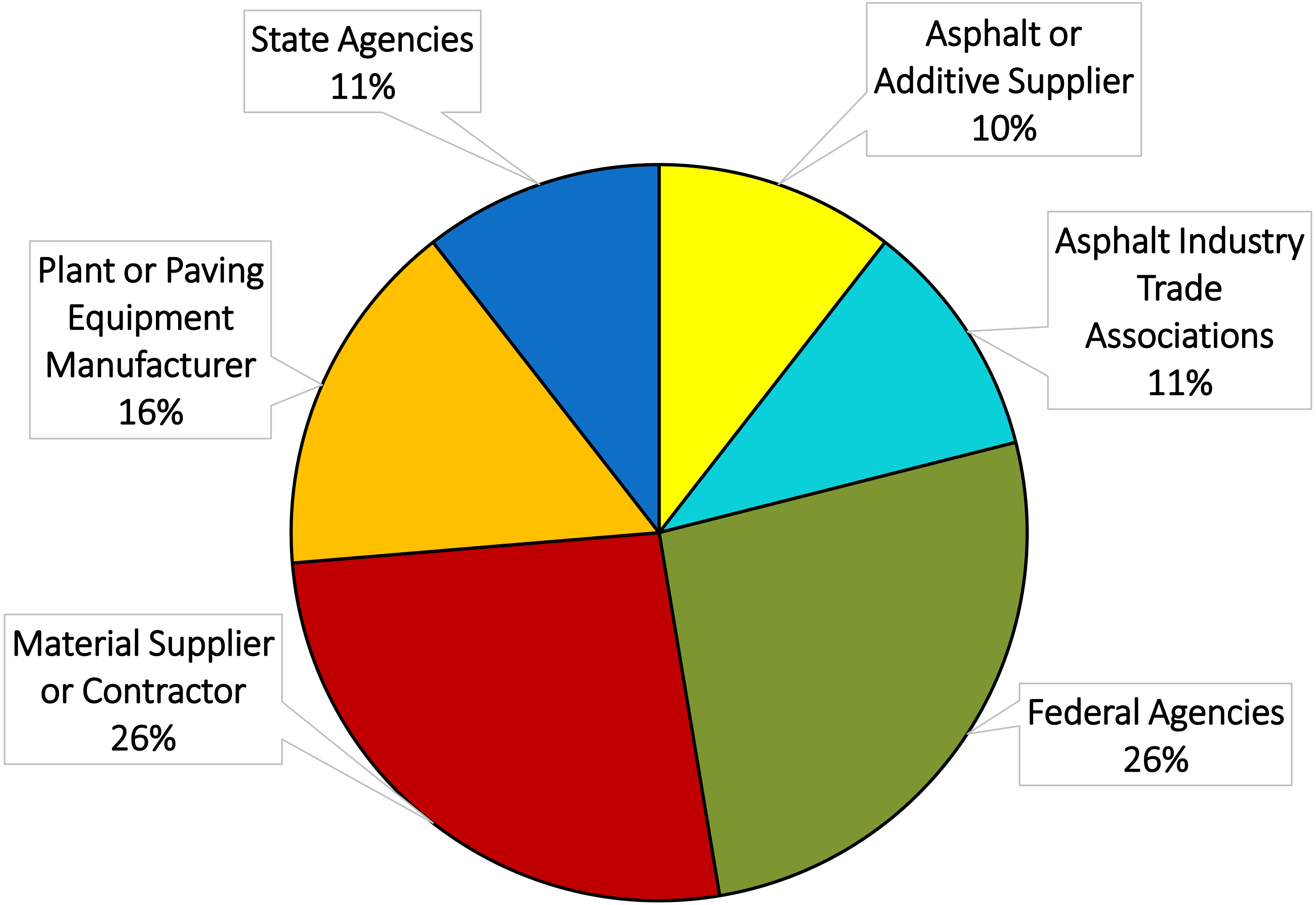

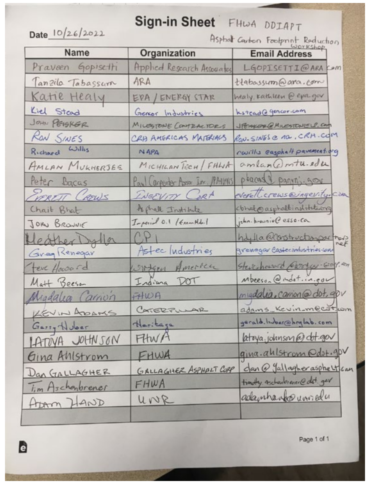

Workshop Organization

Ideas: How to Reduce GHG

- 2 Groups - *Facilitators*
- Open Forum
- Ideas = Post-its on Easels
- Group Ideas
- Rank Ideas
- Report Outs
- Discussion

Constraints

- No Boundaries
  - Planning
  - Procurement
  - Design
  - Materials
  - Production
  - Construction
  - O & M
  - Rehabilitation
  - ….

Pre-Workshop DOT Feedback

- Caltrans
- Colorado DOT
- Indiana DOT
- Oregon DOT

- Don’t compromise Quality (Performance) for Sustainability
  - Lime Anti-strip - Lesson learned/don’t want to re-live it
- How to use Locally Available Aggregates
- BMD implementation to help encourage and allow for lower-GHG materials in asphalt mixtures

Pre-Workshop DOT Feedback

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- Short term:
  - Guidance and education to districts on use of more recycling techniques- CIR, FDR, CCPR
  - Continued smoothness requirement on asphalt pavement
  - Pilot the use of higher RAP (up to 40%)
  - FHWA climate challenge project to reduce asphalt production temperature by using WMA
  - Reducing aggregate moisture contents
- Longer-term:
  - BMD implementation to help encourage and allow for lower-GHG materials to be used in asphalt mixtures
  - How to use locally available aggregates
  - Research impacts of alternatives with BMD
  - EPDs on the asphalt side
  - Renewable fuels at plants
  - Increased RAP percentages
  - Pavement smoothness

Ideas

Mix Consolidation
- change overs
- Waste

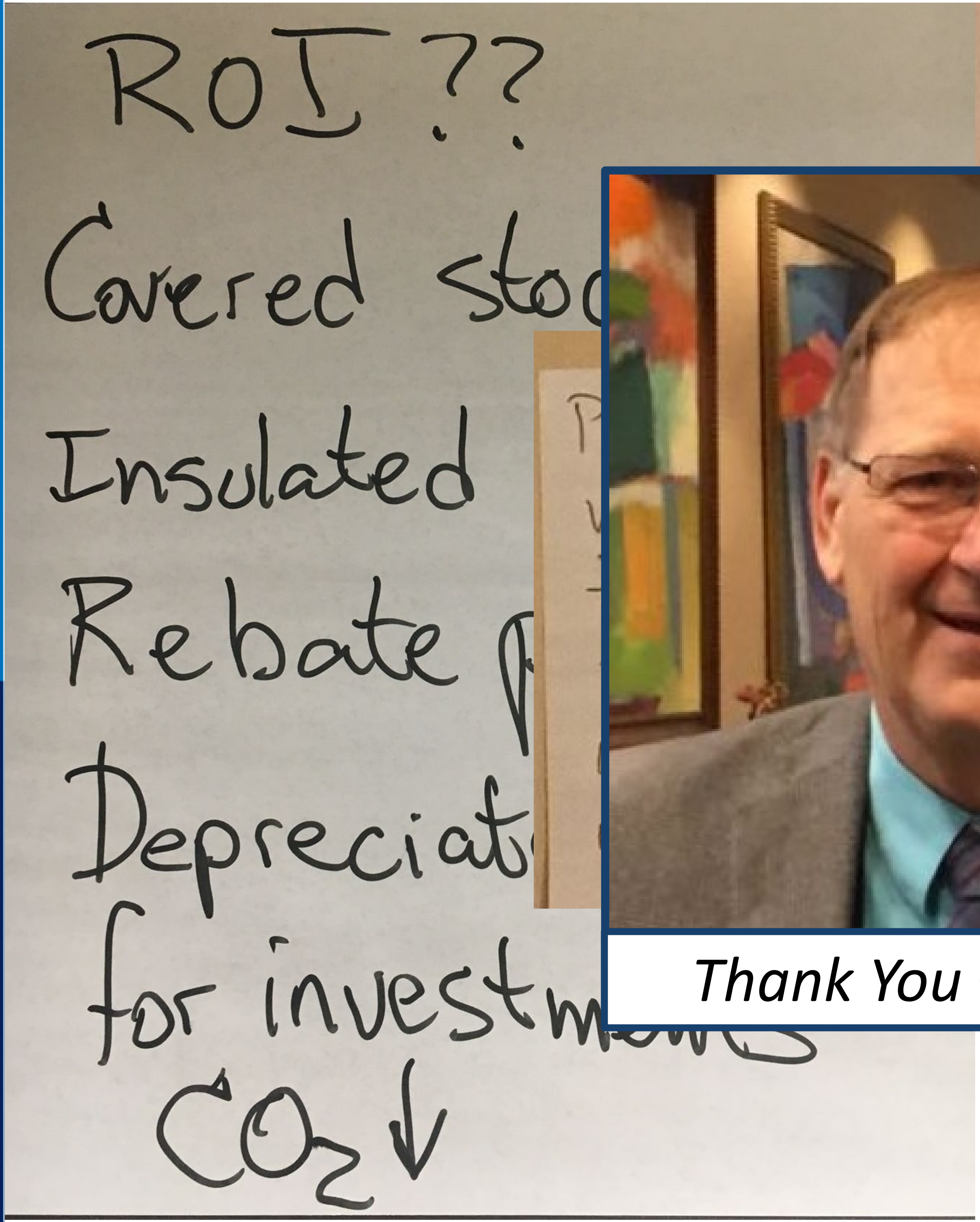
Envir QC
NAPA Optimizes
Plant Operator decision tool (art)
Mix temp

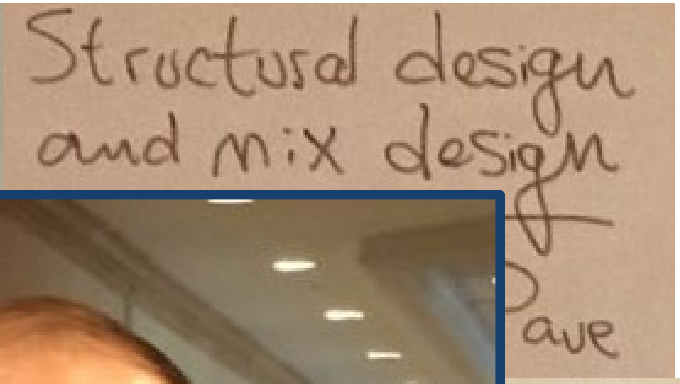
Manure
Used cooking oil
Animal fat.

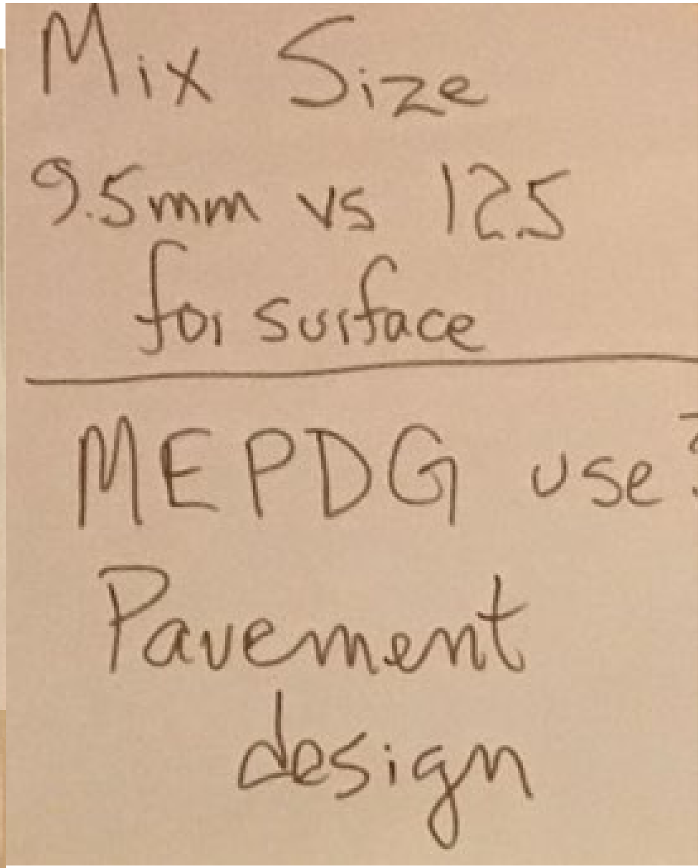
Net Balance
~~Net~~ Zero
Plant rate
Moisture
Operate for convenience not ~~cat~~ efficiency

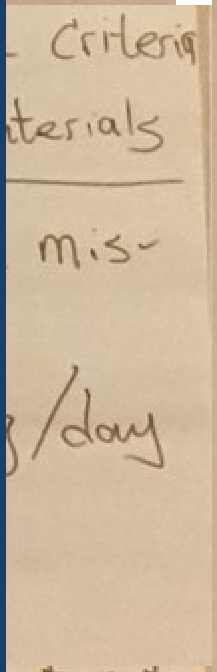
CIR
* CCPR 5 Kg/t
HMA 55 Kg/t

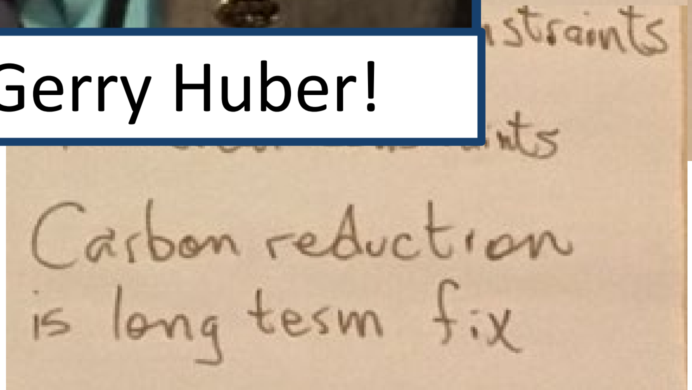
* NCAT test track
VADoT
China
RAP piles in Urban areas
Pavement of future
CIR with overlay











Thank You Gerry Huber!

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Ideas

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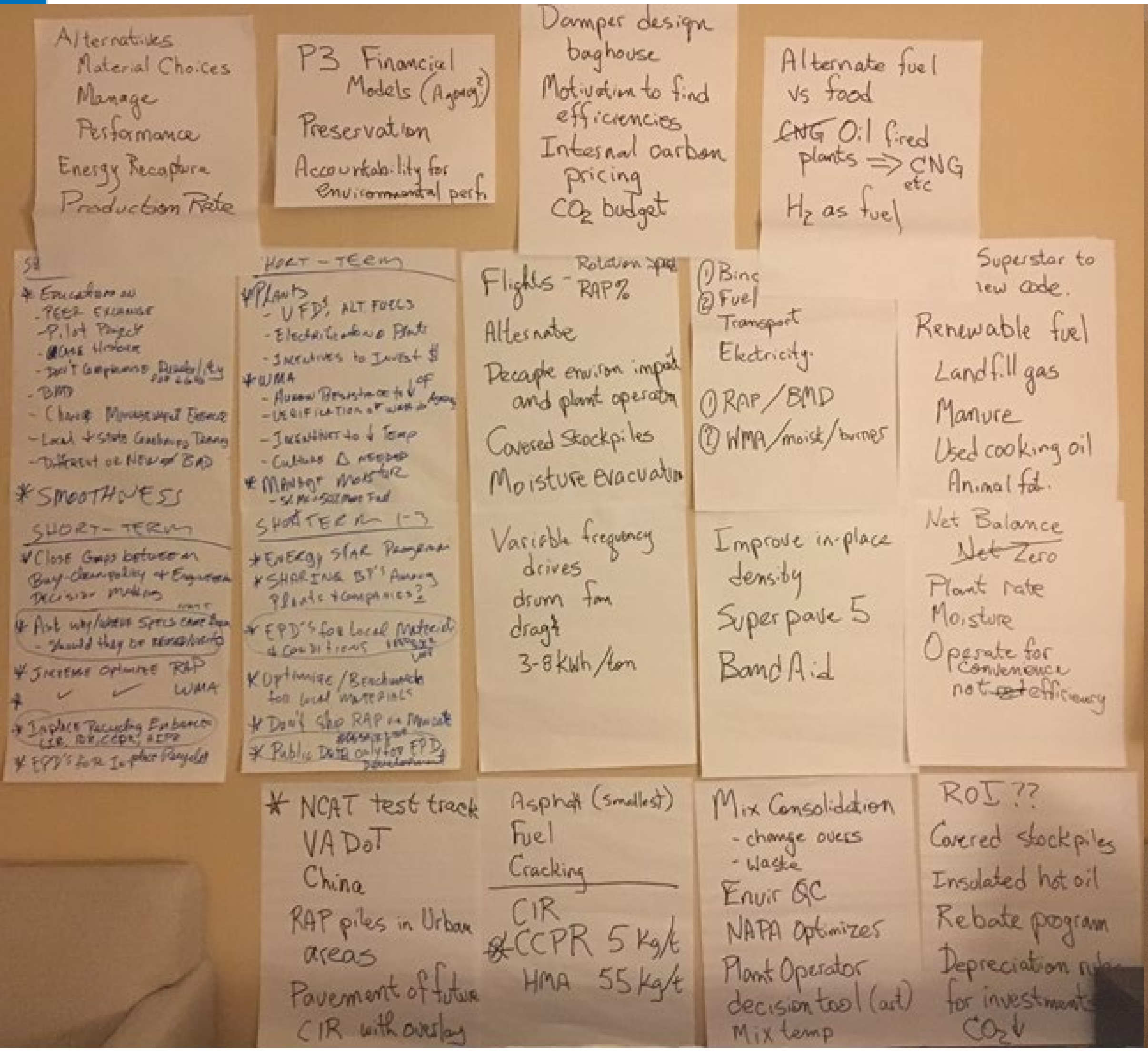

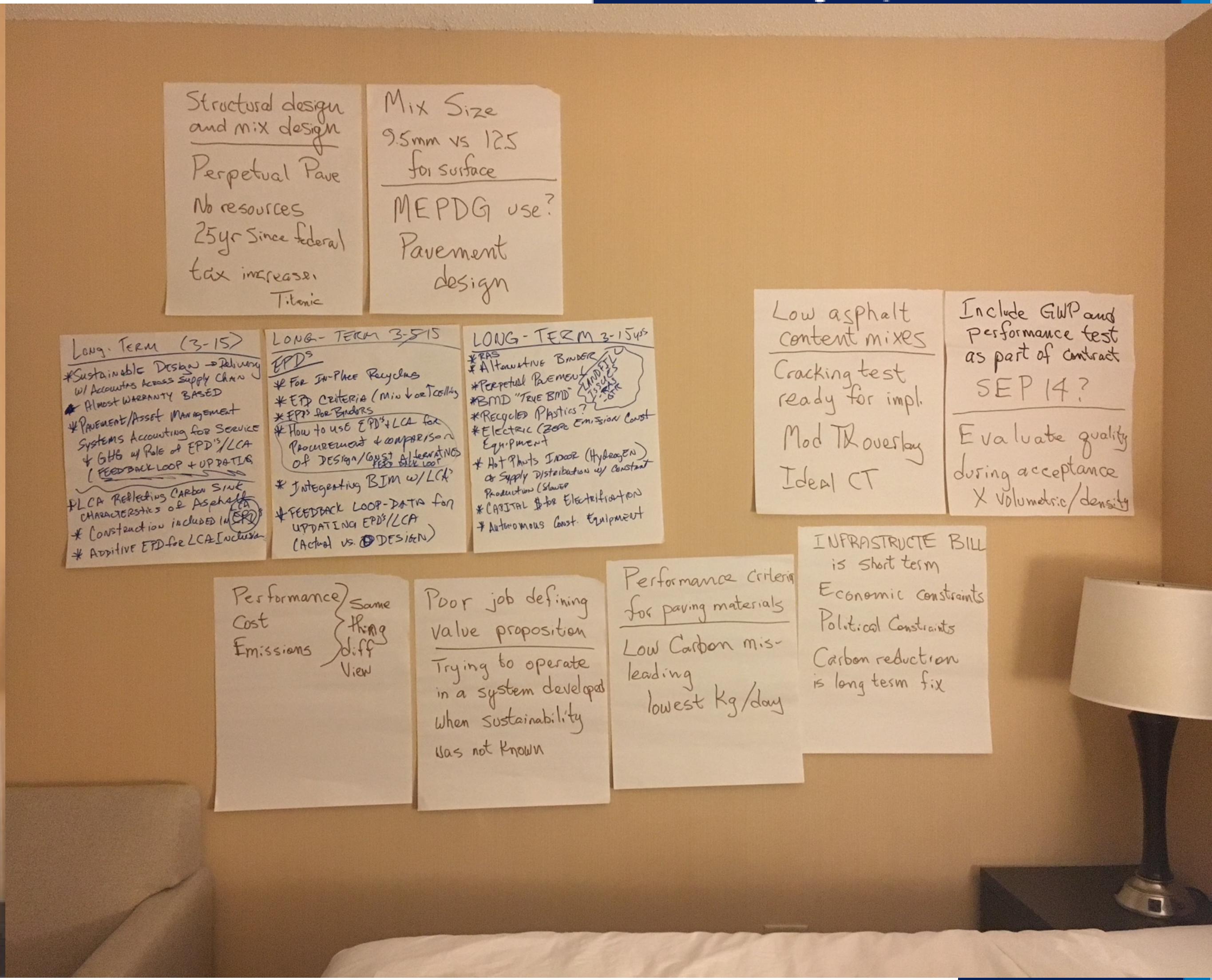

Short-Term Opportunities (0-3yrs)

1. Education
2. EPDs
3. LCA
4. Close Gaps between Buy Clean Policy and Engineering Decision Making
5. Energy Star
6. BMD Implementation
7. Increase Recycled Materials (RAP)
8. Increase WMA at Lower Temps
9. Use of Local Materials
10. Energy Consumption at Hot Plants
11. Smoothness
12. Density
13. Perpetual Pavements / Different Pavements & Preservations Techniques
14. In-place Recycling CIR, FDR, CCPR
15. Incentives to Implement/Use/Optimize Any/All Above
16. QA Programs
17. Depreciation Rules for Investments
18. Quantify and Communicate CO_2 Reductions to Date
19. Defining the Value Proposition – with CO_2 consideration today
20. Specification Changes: WMA, Mix Types, etc. with reality of producer market

Longer-Term Opportunities (3-5yrs)

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1. Sustainable Design with Accountability Across Supply Chain & Verification
2. Pavement/Asset Management Systems Accounting for Performance & GHGs with EPDs/LCA for Feedback and Updating Models
3. LCA Reflecting Carbon Sink Characteristics of Asphalt
4. Construction Included in EPDs (really LCA)
5. EPDs for Asphalt Binder
6. EPDs for Additives (beyond Binder, Agg & RAP)-LAS, WMA, Fibers, …
7. EPDs for In-Place Recycling Techniques
8. How to use EPDs in Procurement Processes
9. EPD Criteria for Use: (Min GHG Reduction? or Max GHG? or ?)
10. How to use EPDs for Comparison of Design & Construction Alternative (granularity also)
11. Integrating BIM in LCAs
12. Feedback/Verification of EPDs/LCA (Design vs. Actual) Over Time
13. Perpetual Pavements Design (MEPDG? Other?) & BMD Mix Design – Idealistic vs. Resources?
14. Alternative Binders (Non-Petroleum Based)

Longer-Term Opportunities (3-5rs)

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15. Include GWP & Performance Tests as part of Contract
16. SEP14? Evaluate Quality During Acceptance vs. Volumetrics & Density
17. Infrastructure Bill is Short-Term: Economic Constraints, Political Constraints while Carbon Reduction is Long-Term Fix

Post-Workshop Ranking Survey

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- Two Methods
  - Highest Priority
  - Functional Themes
- Highest Priority
  - Short-term Opportunities (Table 1)
  - Long-term Opportunities (Table 2)
- Functional Themes
  - Policy / Education Opportunity Rankings (Table 3)
  - Materials / Design / Plant Opportunity Rankings (Table 4)
  - Procurement Opportunity Rankings (Table 5).

Short-Term: Priority Rankings

Rank	Short-term Opportunities
1-a	Implement the use of Life Cycle Assessment (LCA) for information purposes
1-b	Increase the use of Warm Mix Asphalt (WMA) at reduced production temperatures
2	Provide continued education on reducing asphalt carbon footprint
3	Implement the use of Balanced Mix Design (BMD)
4-a	Agency use of perpetual pavement design method and pavement preservations techniques
4-b	Promote use of cold in-place recycling (CIR), cold central plant recycling (CCPR), and full depth reclamation (FDR)
4-c	Make agency specification changes (WMA, mixture types, etc.) considering local asphalt producer market conditions
5-a	Implement the use of Environmental Product Declarations (EPDs) for information purposes
5-b	Close gaps between Buy Clean Policy and engineering decision making
5-c	Incentives to Implement/Use/Optimize All Identified Opportunities
6-a	Increase the use of Reclaimed Asphalt Pavement (RAP)
6-b	Reduce energy consumption at asphalt plants (manage moisture, burners, variable frequency drives (VFDs), insulation
6-c	Implement density specifications or increase incentives for improved density
7	Enhance quality assurance (QA) programs to improve quality
8-a	Promote the use of locally available materials (i.e. aggregates)
8-b	Implement smoothness specifications or increase incentives for improved smoothness
8-c	Revise depreciation rules to incentivize asphalt producers to investment in equipment that reduces carbon footprint
9	Defining the value proposition for reducing carbon emissions
10	Support implementation of the EPA Energy Star program for asphalt plants
11	Quantify and communicate carbon emission reductions to date

Long-Term: Priority Rankings

Rank	Long-term Opportunities
1	Tool for developing EPDs for In-place Recycling Techniques
2	Develop alternative (non-petroleum based) binders
3	Tool for developing EPDs for Additives (beyond Binder, Agg & RAP) such as liquid anti-strip, WMA, fibers, etc.
4	Develop asphalt pavement EPDs including construction
5	Consider that the Infrastructure Bill is short-term with economic and political constraints while carbon reduction is a long-term objective
6-a	Develop LCA reflecting carbon sink characteristics of asphalt
6-b	Develop feedback/verification of LCA/EPDs (design versus actual) over time
6-c	Perpetual Pavements Design (MEPDG? Other?) & BMD Mix Design – Idealistic vs. Resources?
6-d	Assess the ability to use alternative contracting methods per FHWA SEP 14 to evaluate quality during asphalt pavement acceptance
7-a	Tool for developing EPDs for asphalt binders
7-b	Define rational criteria for EPDs: minimum GHG reduction or maximum GHG production or ?)
8-a	Define how to use EPDs in procurement processes
8-b	Determine how to use EPDs for comparison of design and construction alternatives
9-a	Sustainable design with accountability across supply chain with verification
9-b	Implementation of pavement/asset management systems accounting for performance and GHGs with EPDs/LCA for feedback/updating Models
10	Integrate Building Information Modeling (BIM) in LCAs
11	Include global warming potential (GWP) and performance tests as part of contract requirements

Policy/Education Opportunity Rankings

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Rank	Short-term Opportunities	Rank	Long-term Opportunities
1-a	Implement the use of Life Cycle Assessment (LCA) for information purposes	5	Consider that the Infrastructure Bill is short-term with economic and political constraints while carbon reduction is a long-term objective
2	Provide continued education on reducing asphalt carbon footprint	6-a	Develop LCA reflecting carbon sink characteristics of asphalt
5-a	Implement the use of Environmental Product Declarations (EPDs) for information purposes	6-b	Develop feedback/verification of LCA/EPDs (design versus actual) over time
5-b	Close gaps between Buy Clean Policy and engineering decision making	7-b	Define rational criteria for EPDs: minimum GHG reduction or maximum GHG production or ?)
8-c	Revise depreciation rules to incentivize asphalt producers to investment in equipment that reduces carbon footprint	9-b	Implementation of pavement/asset management systems accounting for performance and GHGs with EPDs/LCA for feedback/updating Models
9	Defining the value proposition for reducing carbon emissions	10	Integrate Building Information Modeling (BIM) in LCAs
10	Support implementation of the EPA Energy Star program for asphalt plants		
11	Quantify and communicate carbon emission reductions to date		

Materials/Design/Plants Opportunity Rankings

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Rank	Short-term Opportunities	Rank	Long-term Opportunities
1-b	Increase the use of Warm Mix Asphalt (WMA) at reduced production temperatures	1	Tool for developing EPDs for In-place Recycling Techniques
3	Implement the use of Balanced Mix Design (BMD)	2	Develop alternative (non-petroleum based) binders
4-a	Agency use of perpetual pavement design method and pavement preservations techniques	3	Tool for developing EPDs for Additives (beyond Binder, Agg & RAP) such as liquid anti-strip, WMA, fibers, etc.
4-b	Promote cold in-place recycling (CIR), cold central plant recycling (CCPR), & full depth reclamation (FDR) techniques	4	Develop asphalt pavement EPDs including construction
4-c	Make agency specification changes (WMA, mixture types, etc.) considering local asphalt producer market conditions	6-c	Perpetual Pavements Design (MEPDG? Other?) & BMD Mix Design – Idealistic vs. Resources?
6-a	Increase the use of Reclaimed Asphalt Pavement (RAP)	7-a	Tool for developing EPDs for asphalt binders
6-b	Reduce energy consumption at asphalt plants (manage moisture, burners, variable frequency drives (VFDs), insulation		
6-c	Implement density specifications or increase incentives for improved density		
7	Enhance quality assurance (QA) programs to improve quality		
8-a	Promote the use of locally available materials (i.e. aggregates)		
8-b	Implement smoothness specifications or increase incentives for improved smoothness		

Procurement Priority Rankings

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Rank	Short-term Opportunities	Rank	Long-term Opportunities
5-c	Incentives to Implement/Use/Optimize Any/All Identified Opportunities	6-d	Assess the ability to use alternative contracting methods per FHWA SEP 14 to evaluate quality during asphalt pavement acceptance
		8-a	Defined how to use EPDs in procurement processes
		8-b	Determine how to use EPDs for comparison of design and construction alternatives
		9-a	Sustainable design with accountability across supply chain with verification
		11	Include global warming potential (GWP) and performance tests as part of contract requirements

Outline

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Wrap Up

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- To Public Agencies:
  - Being sustainable is good engineering is stewardship of public dollars and resources
  - Opportunity lost with no action on available federal $ and lower costs to produce
- To Everyone:
  - If we partner we will advance our goal of reducing climate change
  - Who we were, who we are now, future state who we want to be, help us get there
  - Because we need to find ways of reducing impact on the environment AND maintaining our quality of life
  - A new opportunity to review everything we do to improve efficiency environmentally and economically
  - For economic benefits and control of regulations
  - Top down internal pressure, 35%-2025, 50%-2030, Net 0-2050, embodied carbon/asphalt hasn't reduced and we need to change

Why?

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- To Customers/End Users:
  - Creating maximum value at the lowest total cost with respect for people
- To DOTs/Contractors:
  - Cost savings from materials and construction on best practices: RAP/In-place Recycling/WMA/Density/Smoothness
- To Producers:
  - More efficient plant operations lead to reduced raw material consumption and cost savings
  - We must become "invisible" in order to remain an industry allowed to exist near population centers: no visible emissions, odor sound, or dust
  - Here's the business case for lowering the carbon footprint

Why? – Responses from Participants

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- To Employers:
  - Support the ability to bring the best and brightest people into our industry
  - Youth understand and appreciate sustainable actions

Summary

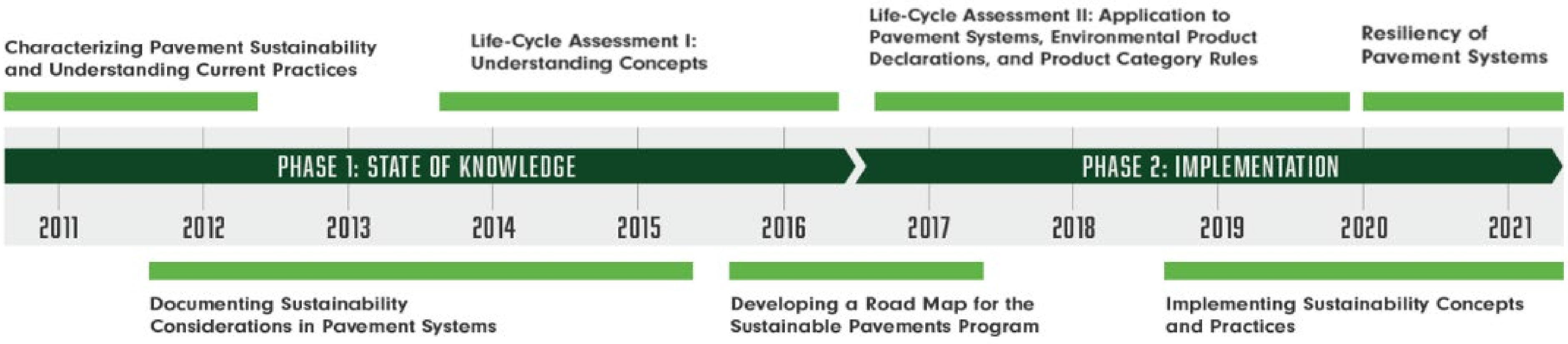
- Stakeholder workshop held
- Short- and long-term techniques to reduce asphalt pavement carbon footprint identified
  - Techniques Ranked by Priority
  - Techniques Ranked by Functional Themes
- TechBrief Published
- Significant FHWA Activity on the Topic
- Opportunities for All

References

1. https://www.sustainability.gov/federalsustainabilityplan/
2. https://www.asphaltpavement.org/climate/learn-more
3. https://www.fhwa.dot.gov/pavement/sustainability/twg.cfm
4. https://www.trb.org/Main/Blurbs/179331.aspx
5. https://dot.ca.gov/programs/engineering-services/environmental-product-declarations
6. https://www.codot.gov/business/designsupport/materials-and-geotechnical/epd
7. https://www.gsa.gov/about-us/newsroom/news-releases/gsa-lightens-the-environmental-footprint-of-its-building-materials-03302022

Other Related Items

- FHWA Sustainable Pavements Technical Working Group (SPTWG) https://www.fhwa.dot.gov/pavement/sustainability/



- Recent FHWA Cooperative Agreement Awards
  - FHWA Advancing Sustainability & Resilience in Pavements, 2023
  - FHWA Development and Deployment of Innovative Asphalt Pavement Technologies, 2023

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Other Related Items

- Low-Carbon Transportation Materials Grants Fact Sheet
  https://www.fhwa.dot.gov/inflation-reduction-act/fact_sheets/lctm_grants.cfm
- FHWA Inflation Reduction Act Fact Sheet
  https://www.fhwa.dot.gov/inflation-reduction-act/
- EPA Interim Determination
  https://www.epa.gov/system/files/documents/2023-01/2022.12.22%20Interim%20Determination%20on%20Low%20Carbon%20Materials%20under%20IRA%2060503%20and%2060506_508.pdf

Thank You

Q & A

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