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Asphalt Pavement Carbon Footprint Reduction Workshop

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 pavement construction via Life Cycle Assessment (LCA) (3).

Some State DOTs have begun to use Environmental Product Declarations (EPDs) for construction materials procurement (4). Interest in EPDs was reflected in a workshop at the 2022 Transportation Research Board (TRB) annual meeting titled, *Use of Life Cycle Assessment in Public Procurement: State of Practice*, and a TRB sponsored webinar on the same topic. EPDs are a tool that can be used to identify materials with lower carbon footprint as desired by Buy Clean Acts, such as those passed in California and Colorado in 2021 (5, 6). The U.S. General Services Administration (GSA) has also issued new asphalt and concrete standards for GSA construction, modernization, and paving projects (7).

All these asphalt pavement stakeholders are working towards a common goal of Net-Zero Emissions by 2050 and use of technologies and tools to rationally quantify the environmental impacts of asphalt pavement materials and construction alternatives. Achieving the common Net-Zero goal will require incremental improvements over time. In the short-term some agencies and industry leaders are already planning for changes and implementing tools to contribute to the Net-Zero goal. Others are critically thinking about impediments that currently exist, or may exist in the future, and how to overcome them.

Objective

The objective of this effort was to organize, document and communicate techniques to reduce asphalt pavement carbon footprint identified in a workshop. The workshop provided a forum for State DOTs, FHWA, asphalt binder producers, asphalt plant manufacturers, paving equipment manufacturers, and asphalt mixture producers and contractors to share current practices as well as short-term or long-term strategies to reduce carbon footprint. From these results technical experts can estimate the magnitude of carbon footprint reduction associated with such activities.

Planned outcomes of the workshop included summaries of techniques that could be applied in the short-term, defined as 0 to 2 years, and the long-term, defined as 3-5 years. Electronic media was used to get each workshop participants priority ranking of the identified short- and long-term techniques for reducing asphalt pavement carbon footprint. This Technical Brief includes a description of the workshop along with the short- and long-term techniques for reducing asphalt pavement carbon footprint identified through it.

Carbon Footprint Workshop Structure

The one and one-half day in-person workshop took place in Chicago Illinois on October 26-27, 2022. There were 24 participants at the workshop, which included two facilitators and two notetakers. Figure 1 shows the distribution of workshop participant affiliations.

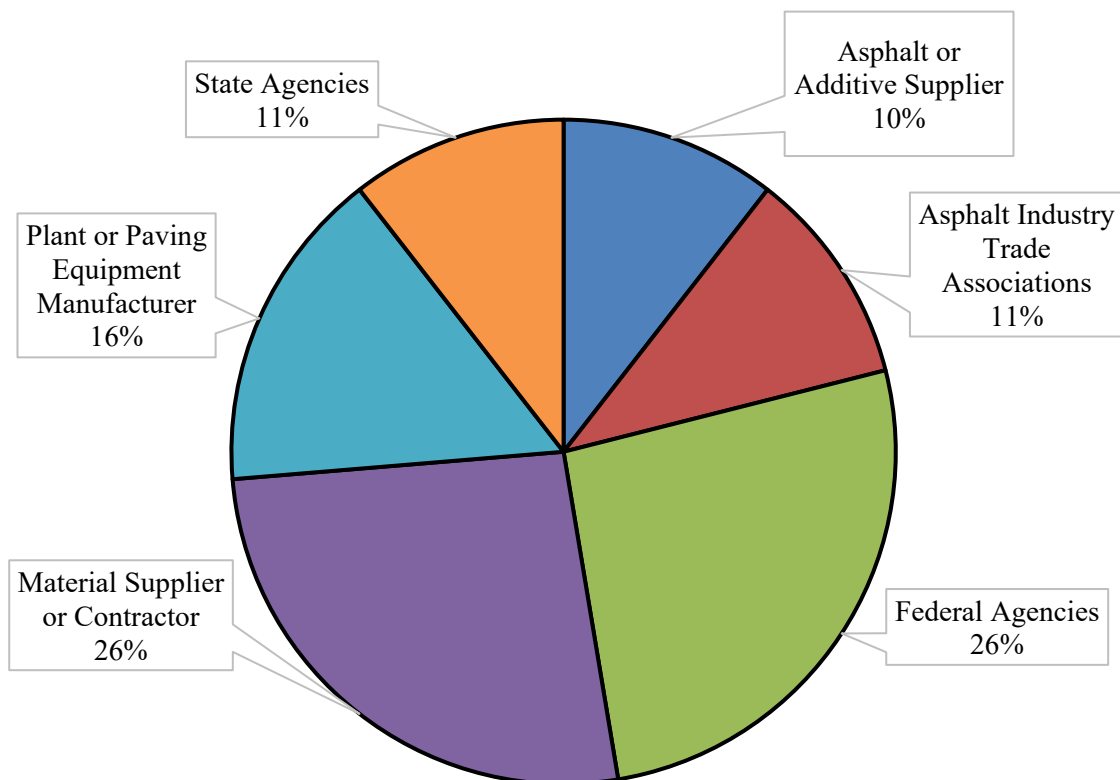


Figure 1. Distribution of Workshop Participant Affiliations.

Figure 2 shows the workshop agenda. The morning of the first day the participants received relevant context on the Federal Sustainability Plan, which has goals to reduce Federal Operations emissions by 65 percent by 2030 and achieve Net-Zero Emissions by 2050, as well as the National Asphalt Pavement Association (NAPA) Road Forward sustainability vision with a net-zero carbon emissions goal by 2050 (1, 2). Back-to-back breakout sessions followed to identify short- and long-term opportunities to reduce asphalt pavement carbon footprint.

For each breakout session two equal size groups of participants with a similar blend of affiliations were formed. Each group had a facilitator and note taker. The facilitators were charged with engaging participants to participate while not allowing any individual or affiliation to have excess input. Each session started with a reminder of the workshop objectives and requests for ideas for reducing asphalt pavement carbon footprint that were captured by each participant on small post-it-notes. There were no constraints placed on the number of ideas other than they had to be items that could be achieved in either the short-term (0-2 years) or long-term (3-5 years or more). Each participant placed their post-it-notes on a wall and explained what their ideas were. Other participants were encouraged to ask questions to make sure the ideas were understood and that the time frames (short- or long-term) were appropriate for the ideas. As this was done, the facilitators moved post-it-notes to group common ideas or themes and shared them with the participants asking for clarification and if groupings needed to be revised. All participants then convened to hear a report out on the ideas with open questions and answers.

Agenda	
FHWA DDIAPT	
Asphalt Carbon Footprint Reduction Workshop Agenda	
October 26-27, 2022	
<i>DoubleTree by Hilton O'Hare-Rosemont; 5460 North River Road; Rosemont, IL 60018</i>	
Wednesday October 26, 2022	
Time	Topic
8:00-8:30 am	Welcome, Introductions, Objectives, and Intended Outcomes
8:30-9:00 am	FHWA Sustainability Activities & Plans
9:00-9:30 am	Asphalt Industry Activities & Plans
9:30 am	Break
9:45-noon	Breakout Session 1: Short-Term Opportunities
noon	Lunch Break
1:00-3:00 pm	Breakout Session 2: Longer-Term Opportunities
3:00 pm	Break
3:15-5:00 pm	Report Outs
Thursday October 27, 2022	
Time	Topic
8:00-8:15 am	Objectives and Intended outcomes
8:15-10:15 am	Breakout Session 3: How do we get it done?
10:15 am	Break
10:30-11:45 am	Report Outs
11:45-noon	Wrap, Future Correspondence
Noon	Adjourn

Figure 2. Carbon Footprint Workshop Agenda.

There were three State DOT participants that had planned to attend the workshop, but ultimately were not able to participate. The State DOT participants provided input via email with the request that attending State DOT participants share their input during the workshop. The following short-term items emerged from the email exchange:

- Pavement quality and performance should not be compromised to reduce carbon emissions.
- More use of asphalt cold recycling techniques (cold in-place, cold central plant, and full depth reclamation).
- Pilot the use of higher RAP doses.
- Leverage the FHWA Climate Challenge to reduce production temperature using WMA.
- Aggregate moisture management.

The following long-term items were identified:

- Focus on implementing the use of Environmental Product Declarations (EPDs).
- BMD implementation should help encourage and allow for lower-GHG materials use in asphalt mixture.
- Increased RAP percentage.
- Improved pavement smoothness.

An example was used to reinforce the first short-term point. One of the State DOTs uses hydrated lime as an antistrip additive and would continue to do so as it is much more effective than liquid antistrip, even though the carbon footprint of lime may be greater than liquid antistrip additives. This illustrates pavement durability is a priority to the DOT. This information was shared with the workshop participants during the afternoon of the first day.

The second day of the workshop started with a summary of Day One. Short- and long-term ideas to reduce asphalt pavement carbon footprint were summarized on large (easel size) post-it-notes on the walls and in an MS PowerPoint presentation for review and consensus on them. This was followed by a review of short-term versus long-term items as some items appeared on both short-and long-term lists forcing clarification and ultimately consensus on appropriate listing of items. A total of 20 short-term and 17 long-term items were identified.

The remainder of the second day was spent discussing how to prioritize the identified short- and long-term opportunities. A consensus formed that education of asphalt pavement stakeholders was a critical need. The education should be focused on the short-term even though education had not been identified as a technique for reducing asphalt pavement carbon footprint.

Ranking Identified Techniques for Reducing Asphalt Pavement Carbon Footprint

The workshop participants ranked the importance of 20 short-term and 17 long-term techniques for reducing asphalt pavement carbon footprint on a scale of 1 to 5, with 1 being the highest level of importance and 5 being the lowest level of importance. This was done via electronic media so individual participants rankings were anonymous. The composite rankings, based on responses from 17 participants, for the short- and long-term techniques are presented in Table 1 and Table 2, respectively.

It is important to recognize that the ranking was not done in the context of a specific project, but rather in the context of positive impacts the techniques could provide. When identifying and ranking techniques for reducing asphalt pavement carbon footprint for a specific project there will always be tradeoffs because the context of every project is unique and a technique that is a priority on one project may not be a priority on another project due to the project specific conditions.

Some techniques were ranked the same and when this occurred, letters were added to the numeric rank to indicate that more than one technique had the same rating. The order within each rank is not distinguished. For example, in Table 1 there are two opportunities that were ranked as “1” to which an “a” and “b” were added behind the number 1. These are listed as 1-a, *Implement the use of Life Cycle Assessment (LCA) for information purposes* and 1-b, *Increase the use of Warm Mix Asphalt (WMA) at reduced production temperatures*. The two opportunities have the same ranking.

The short- and long-term techniques to reduce asphalt pavement carbon footprint are also summarized by functional themes in Table 3 through Table 5. The functional themes are:

- Policy / Education Opportunity Rankings (Table 3).
- Materials / Design / Plant Opportunity Rankings (Table 4).
- Procurement Opportunity Rankings (Table 5).

Summary

An asphalt pavement carbon footprint reduction workshop was held with a broad group of asphalt pavement stakeholders including State DOT, FHWA, asphalt binder producer, asphalt plant manufacturer, paving equipment manufacturer, asphalt mixture producers and contractors. The workshop objective was to identify and rank techniques to reduce asphalt pavement carbon footprint. The workshop identified techniques that participants estimated could be implemented in the short-term (0-2 years) and long-term (3-5 years).

The techniques were priority ranked by the workshop participants. The rankings were not informed by specific data for which demonstrated the potential that these activities could reduce GHG to a specific level and were more a reflection of stakeholder perception and acceptance of the topic with anticipated GHG reductions. The information collected through the workshop may be used by the stakeholders to inform future activities that support asphalt pavement carbon footprint reduction.

Table 1. Short-term Opportunity 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) techniques
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

Table 2. Long-term Opportunity 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	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
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

Table 3. Policy / Education Opportunity Rankings.

Short-term Rank	Opportunities	Long-term Rank	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		

Table 4. Materials / Design / Plant Opportunity Rankings

Short-term Rank	Opportunities	Long-term Rank	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 use of cold in-place recycling (CIR), cold central plant recycling (CCPR), and 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		

Table 5. Procurement Opportunity Rankings.

Short-term Rank	Opportunities	Long-term Rank	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

References

1. <https://www.sustainability.gov/federalsustainabilityplan/>
2. <https://www.asphalt pavement.org/climate/learn-more>
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