NEAUPG-2021
Turning Green to Gold
How Asphalt Industry Can Benefit from Upcoming Climate Regulations

Chandra K. Akisetty, MDOT SHA
Qingbin Cui (QC), University of Maryland

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GHG at Project Level

- On-road vs Off-road
- 2012 MAP-21 mandates broad performance measures
- 2014 FHWA released Infrastructure Carbon Estimator (ICE)
  - Upstream (material production)
  - Construction (material transport, construction equipment, and maintenance)
  - Emission models developed in WA, UT, CO, VT, MA, and MD
- 2016 CEQ issued final guide for project-level GHG emissions
- 2016 FHWA proposed the inclusion of GHG measures in new construction and issued the rule in Jan 2017
- 2018 FHWA repealed the GHG rule after a formal public-notice-and-comment rulemaking process
Biden’s Climate Policy

- The White House on April 23, 2021 “Enhancing climate ambition and enabling the transformations required to reach net-zero emissions by 2050
  - “achieve net-zero emissions, economy-wide, by no later than 2050.”
  - [https://joebiden.com/clean-energy/](https://joebiden.com/clean-energy/)

- The White House on April 23, 2021: achieve 50-52% reduction goal in U.S. GHG emissions from 2005 levels by 2030!

- HB 3684 Infrastructure Investment and Jobs Act
  - “A State... shall develop a carbon reduction strategy ... [that] shall ... (D) at the discretion of the State, quantify the total carbon emissions from the production, transport, and use of materials used in the construction of transportation facilities within the State”

The Time is Now!
What Does It Mean for the Pavement Industry?

- GHG emissions included in NEPA
- State DOT includes GHG emissions as a performance measure
- Contractors must meet emission goals in projects determined by State DOTs
- Adoption of low-carbon materials, equipment, and construction methods
- Compliance requirements and increased cost

- AND… we are doing good to the environment
Our Approach: Transforming Environmental Liability to Economic Asset and Revenue

VCS Methodology

VM0039
Methodology for Use of Foam Stabilized Base and Emulsion Asphalt Mixtures in Pavement Application

Version 1.0
24 June 2019
Sectoral Scope 6

Our methodology was approved in 2019 and can be found on the Verra/VCS website:
https://verra.org/methodology/vm0039-methodology-for-us-of-fsb-in-pavement-application-v1-0/

Our team worked from 2013 – 2019 to get this methodology approved.
Emission Data Collection

- Majestic lane, Fairfax, VA
- Belle view blvd, Alexandria, VA
- Arlington drive, Alexandria, VA
- Boone blvd #500, Vienna, VA
- West columbia st, Falls church, VA
- Fran Place, #104, Alexandria, VA

- Stebbing way, Laurel MD
- Nantucker Dr., Crofton, MD
- Georgia avenue, Sliver spring, MD
- Landover hills, MD
- Forest drive, Annapolis, MD
- Gaither road, Gaithersburg, MD
- Prince Phillp Dr., Olney, MD

Facility data  Project data
HMA Emission Sources

ASPHALT CONCRETE RECYCLING

RAW MATERIAL PRODUCTION

CO\textsubscript{2}

-325 F

5% Bitumen

20% RAP

Bitumen production

Aggregates production

Transport

Cold Bins

Cold milling machine

RAP

Haul to central plant

Crushing

Aggregates

ON-SITE INSTALLATION

Paving

Compaction

HMA pavement product delivered

HMA Storage

Drum Mixer

Heater

75%

20% RAP

On-site office

HMA Emission by Category

<table>
<thead>
<tr>
<th>Category</th>
<th>CO\textsubscript{2} (kg/MT)</th>
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</thead>
<tbody>
<tr>
<td>Raw material</td>
<td>54</td>
</tr>
<tr>
<td>In-plant production</td>
<td>17.1</td>
</tr>
<tr>
<td>Material delivery</td>
<td>15</td>
</tr>
<tr>
<td>Installation</td>
<td>63.7</td>
</tr>
</tbody>
</table>
Cold Recycling Methods

CIR – Pulverize existing HMA and some of the base materials to make a mix using stabilizing agent. Recycling train does it in-place.

CCPRM – Use the stockpiled RAP and stabilizing agent to produce mix at ambient temperature and deliver to the site for laydown.
CCPR Emissions

Legend: CO₂ emissions from 1) diesel use; 2) chemical process; 3) electricity use

RAW MATERIAL PRODUCTION

- Existing pavement
- Removed using cold-milling machine
- Haul to central plant
- 95.6% Aggregates
- Crushing machine
- Screening

Bitumen production
- Bitumen tank
- ~325 F
- 2.4% Bitumen

Water production
- Water

Cement production
- Cement

CENTRAL PLANT PRODUCTION

- Aggregate
- CO₂ (1)
- CO₂ (3)
- FSB Plant
- ON-SITE INSTALLATION

FSB Plant
- FSB pavement product delivered to customer

Graph:

- Raw materials
- FSB facility
- Job site
- Emission intensity
- Percentage

- E-6
- E-11
- E-9
- E-10
- E-7
- E-8

- CO₂ (1)
- 0.5%
- 9.1%
- 11.7%
- 4.3%
- 4.1%
- 6.0%
- 13.7%
- 20.2%
- 7.5%
- 26.2%
- 9.7%
- 20.2%
CIR Emissions

![Graph showing emissions from raw materials and construction activities.](image)
Turning Green to Gold

1 ton CO₂ Reduction = 1 VCU
Pave Next Example: HMA+CTB vs CCPRM+FDR

Conventional Design Area sans Removal of Existing Material

**Design A: Conventional**

Default Design Mix Plant Distance: 32.7 miles

Total Impact: 51,820 tons CO₂

**Areas**

- Travel Lane and Shoulders: 506,739.2 yd²
  - 2 In HMA (5548), SN 0.88
  - 2.5 In HMA (5550), SN 1.1
  - 3 In HMA (5552), SN 1.2
  - 3 In HMA (5552), SN 1.2
  - 8 In C99, SN 1.6

Thickness: 18.5 In
Impact: 51,820 tons CO₂
Structural Number: 5.98
Green Mix: No

Green Design Example Area (1/4)

**Reconstructed Travel Lanes (CCPRM and FDR)**

199,372.8 yd²

Roadway

Total Impact: 41,177 tons CO₂

- 2 In HMA (5566), SN 0.88
- 2 In HMA (5564), SN 0.88
- 6 In FSB (5568), SN 1.92
- 12 In FDR, SN 2.4

New Layer

- Thickness: 22 In
- Impact: 12,629 tons CO₂
- Structural Number: 6.08
- Green Mix: Yes
Case Study:

Traditional Design
• 51,820 tons CO\textsubscript{2} + 3,200 tons CO\textsubscript{2} for removal of exiting material

Sustainable Design
• 41,177 tons CO\textsubscript{2}

How much does University of Maryland pay for reducing their CO\textsubscript{2} footprint?
• Pays $10/t CO\textsubscript{2} for reduction from international projects
• Pay up to $15/t CO\textsubscript{2} for reductions from in-state projects
• 60,000 t CO\textsubscript{2} / this year goal
• 150,000 t CO\textsubscript{2} by 2025 to achieve net-zero

Savings and Payback for Sustainable Design
• 13,843 t CO\textsubscript{2}
• $138,430 at $10/t CO\textsubscript{2}
• $207,645 at $15/t CO\textsubscript{2}
• $692,150 at $50/t CO\textsubscript{2}
UMD Climate Action Plan – and beyond

- 50% reduction by 2020 (from 2005 levels), carbon neutral by 2025
- 100,000 MTCO2e purchased to offset air travel (50%), commuting (30%), and others
  - UMD air travel inventory: 1.5 MMTCO2e
- All carbon offsets are from international sources and cost at $3 – 10.
Thank You
Backup Slides
Credit Ownership Determination

- Criteria:
  - Project ownership vs emission controllability
  - Emissions from operation vs from construction
- Environmental Social Governance (ESG) reporting liabilities
  - Scope 1, 2, and 3
- Contract and facility acceptance
- VCU application burden
Understanding Scope 1, 2 and 3 Emissions

**Scope 1**
Direct (Owned) Emissions
- ONSITE facility emissions
- direct combustion
- OWNED equipment emissions
- company owned vehicles/equipment

**Scope 2**
Indirect (Purchased) Emissions
- PURCHASED facility energy
  - for electricity, heating/cooling, steam

**Scope 3**
Other Indirect (Purchased) Emissions
- EMPLOYEE emissions
  - travel, commuting
- LEASED ASSETS emissions
  - operations of leased assets
- SUPPLY CHAIN emissions
  - material extraction/production, purchased goods/services, sold goods/services, material waste
## For Any Project These are the Types of Data and Parameters Needed

1. Weight of each raw material used to produce HMA or FSB or asphalt emulsions (kg)
2. Total miles that trucks travelled to supply raw materials to HMA plant or FSB plant
3. Total miles that trucks travelled to supply raw materials to the job site
4. Total miles that trucks travelled to supply products to the job site
5. Electricity consumption of the whole plant (kWh)
6. Output quantity of FSB and asphalt emulsions (t)
7. Total operating hours of on-site use of equipment
8. Total labor hours of on-site use of equipment
9. Density of FSB or asphalt emulsions (lbs/cubic ft)
10. Layer coefficient of FSB or asphalt emulsions
11. Length of damaged pavement (miles)
12. Running speed of cold recycler (mph)