

Low Carbon Transportation Materials (LCTM) Program for Wisconsin DOT

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What is the LCTM Program?

- Goals of LCTM Program in WisDOT
 - Increase use of lower carbon embodied greenhouse gas (GHG) emission in construction projects
 - Improvement in selection of construction materials, process, and equipment
 - Promote technology transfer and workforce development to increase use of LCTM
 - Establish independent self-sustained LCTM program
- LCTM grant will be applicable only for LCTM materials not for entire construction project



Benefits for Wisconsin

- WisDOT
 - Establish the process to administrate more sustainable construction materials
- Industry: Benefit by incentives and/or reimbursements
 - Incentives of the cost of the eligible materials or products
 - When LCTM bid price is lower than non-LCTM bid price
 - Reimbursement: Equal to the incrementally higher cost of using LCTM
 - EPD Development in bid item
 - Opportunity for more innovations

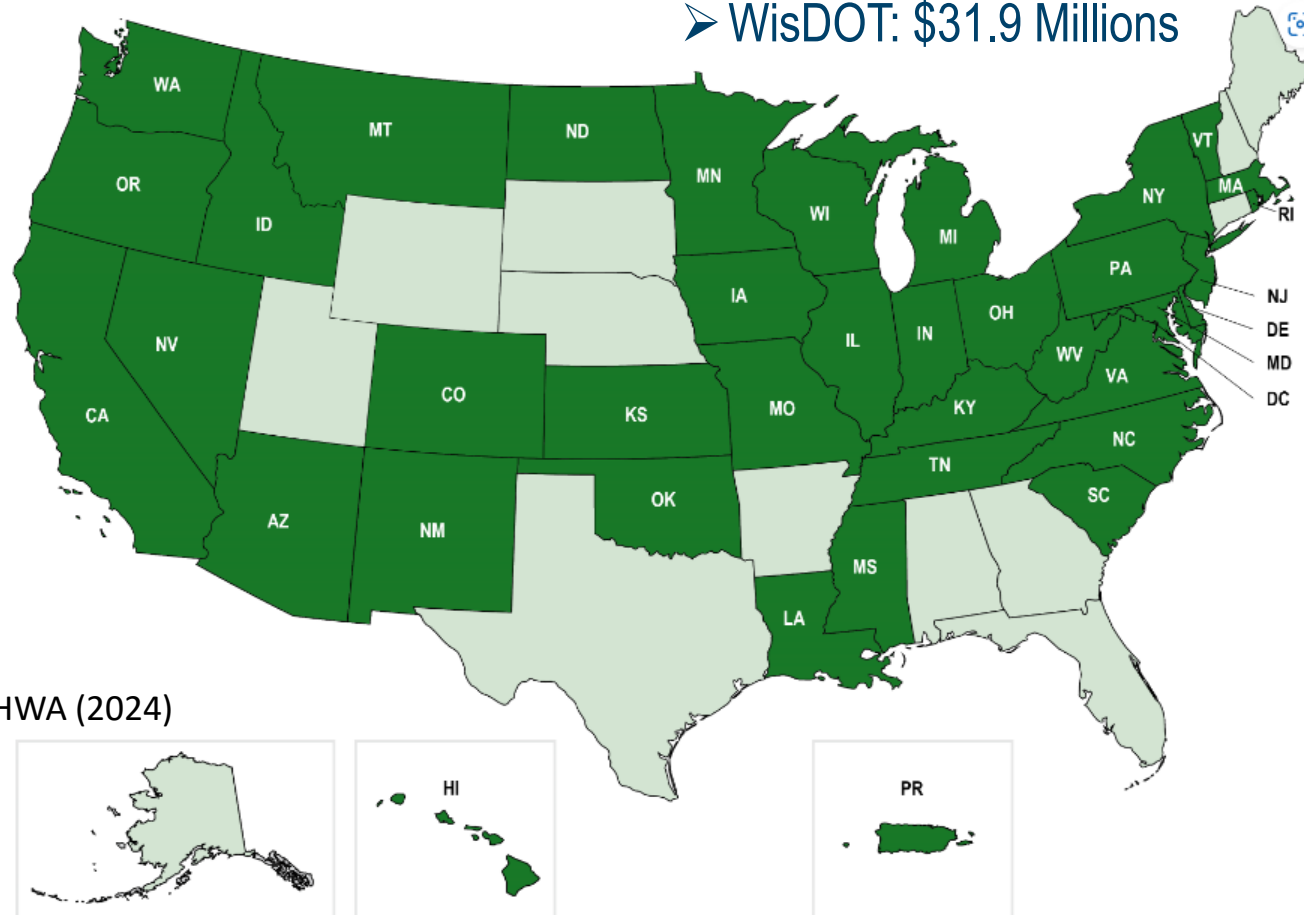


Who is receiving funding & how much?

Low-Carbon Transportation Materials Grants Program

State DOT Grant Award Recipients (FY22 Funding)

- 39 States Recipients
- WisDOT: \$31.9 Millions



FHWA (2024)

What are the objectives of the LCTM Grant?

- WisDOT Objectives

- Establish Process for LCTM Material Identification
- Establish EPD collection and verification process
- Create Special Provisions for eligible materials
- Deploy LCTMs on eligible projects
- Independent self-sustained LCTM program

- Industry Objectives

- Develop EPDs & provide to WisDOT
- Lower GHG emissions via process and equipment improvement, material selection, etc.
- Deploy LCTM techniques on eligible projects.
- Enhance and foster industry innovations



What are the steps to establish and deploy the program?

Milestone 1

- Materials Identification
- EPD collection
- Establish baseline for WisDOT materials
- Determine performance – based materials expectations
- Establish EPD thresholds to increase LCTMs

Milestone 2

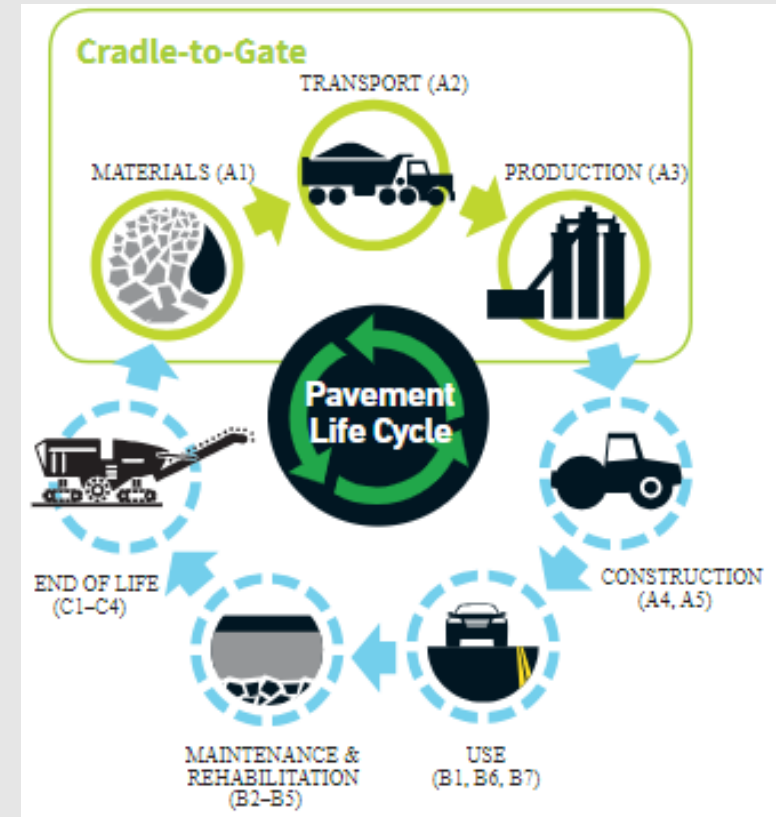
- Create quality verification program (23CFR637) to verify LCTMs from cradle to gate
- Write LCTM program special provisions
- Select pilot projects
- Construct pilot projects
- Collect data

Milestone 3

- Analyze EPD validation data
- Analyze materials performance test data
- Adjust special provisions as necessary
- Continuously improve program to encourage use of LCTMs

What is an EPD?

- Environmental Product Declaration (EPD)
 - Cradle to Gate EPD
 - Quantified environmental impact during three stages
 - Materials (A1), Transport (A2), Production (A3)
- EPD readiness in Wisconsin
 - Six published EPDs available in NAPA (Emerald®)
 - EPD generation cost will be included in bid item.
 - Cost of collecting and storing EPD will be funded by the LCTM grant



Examples of EPD



An Environmental Product Declaration (EPD) for Asphalt Mixtures

TABLE 3. ENVIRONMENTAL IMPACT SUMMARY TABLE

IMPACT CATEGORY	POTENTIAL IMPACT PER METRIC TONNE ASPHALT MIXTURE (PER TON ASPHALT MIXTURE)
Global warming potential (GWP-100)	55.80 (50.62) kg CO ₂ Equiv.
Ozone depletion potential (ODP)	7.80e-08 (7.08e-08) kg CFC-11 Equiv.
Eutrophication potential (EP)	1.12e-02 (1.01e-02) kg N Equiv.
Acidification potential (AP)	1.39e-01 (1.26e-01) kg SO ₂ Equiv.
Photochemical ozone creation potential (POCP)	3.32 (3.01) kg O ₃ Equiv.



TABLE 4. LIFE CYCLE IMPACT INDICATORS

ACRONYM	INDICATOR	UNIT	QUANTITY PER METRIC TONNE ASPHALT MIXTURE (PER SHORT TON ASPHALT MIXTURE)			
			MATERIALS (A1)	TRANSPORT (A2)	PRODUCTION (A3)	TOTAL (A1-A3)
GWP-100	Global warming potential, incl. biogenic CO ₂	kg CO ₂ Equiv.	31.88 (28.92)	0.88 (0.80)	23.05 (20.91)	55.80 (50.62)
ODP	Ozone depletion potential	kg CFC-11 Equiv.	1.67e-08 (1.52e-08)	5.31e-09 (4.82e-09)	5.60e-08 (5.08e-08)	7.80e-08 (7.08e-08)
EP	Eutrophication potential	kg N Equiv.	8.58e-03 (7.78e-03)	2.62e-04 (2.38e-04)	2.32e-03 (2.11e-03)	1.12e-02 (1.01e-02)
AP	Acidification potential	kg SO ₂ Equiv.	9.28e-02 (8.42e-02)	4.49e-03 (4.07e-03)	4.12e-02 (3.74e-02)	1.39e-01 (1.26e-01)
POCP	Photochemical ozone creation potential	kg O ₃ Equiv.	1.94 (1.76)	0.14 (0.13)	1.23 (1.11)	3.32 (3.01)



EPD Collection & Storage

- EPD Collection, Verification, Storage and Update.
 - Collection of EPDs of eligible materials and mixes
 - 120 HMA mixes (40 low volume mixes, 60 Med and high-volume mixes, 20 SMA mixes)
 - Verification of collected EPDs
 - Database management
 - Store and analyzed the collected EPDs
 - Update the EPDs
- National level efforts with other DOTs
 - AASHTO Product Evaluation & Audit Solutions
 - AASHTOWare-Materials
 - Others



How to define LCTM

“substantially lower embodied carbon”

- Definition of substantially lower embodied carbon by EPA
 - Best Performing 20% (lowest 20% in GHG emission)
 - Top 40 % (lowest 40% in GHG emission)
 - better than industry average
- Energy STAR Performance Score when available

EPD Implementation in WisDOT

(Example from GSA)

GSA IRA Limits for

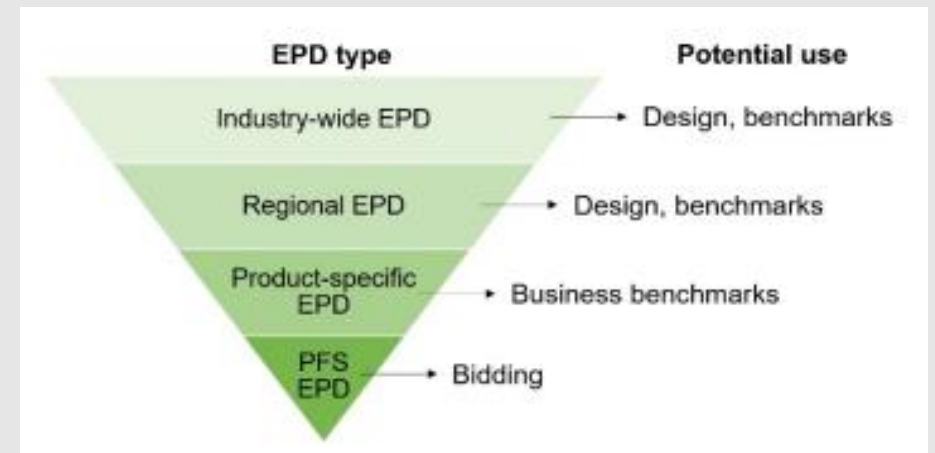
Low Embodied Carbon Asphalt - May 16, 2023

(EPD-Reported GWPs, in kilograms of carbon dioxide equivalent per metric ton - kgCO₂e/ t)

Top 20% Limit	Top 40% Limit	Better Than Average Limit
55.4	64.8	72.6

Establish EPD Thresholds of LCTM

- Thresholds determined by national data
 - Guidance to be provided by FHWA
 - Data collected and analyzed by National Industry Representatives (e.g., NAPA)
 - Reliable process but may require adjustment for regional differences
 - Can be used as a baseline
- Thresholds determined by state data
 - Data collected and analyzed by State
 - Require enough data to set up thresholds
 - Required verification process



FHWA (2021)

Development of Material Specifications & SPVs - WisDOT

- Material Specifications or Special Provisions (SPVs) specific to the LCTM Program
 - Development of performance-related SPVs with QC and QA for acceptance
 - Criteria for incremental or incentive amount per eligible materials
 - It will not be applied to all projects, only selective projects
 - Teamwork with industry (e.g., HMA Tech Team) and FHWA to develop SPVs
 - Maintain good quality with LCTM by following Quality Verification Program (23 CFR 637)



Quality Verification

- Conformance to the Quality Verification Program (23 CFR 637)
 - Sustainability is a performance!
 - Quality Assurance Program to verify the performance of using LCTMs
 - Independent Assurance Program
 - Verification sampling and testing
 - Random sampling
 - Eligible, quantifiable, measurable, verifiable materials, process and equipment



Selection & Construction of Pilot Projects

- Pilot Projects

- Selection of eligible projects to pilot LCTM specific Material Specifications and SPVs
- Examples Eligible activities for contractors
 - EPD Collection in Bid item
 - Incentives and/or increase of cost by applying LCTM
 - Process to place LCTM
 - Implement performance related testing
 - Monitoring performance of the projects
 - Identify required additional processes to use LCTM



Eligible Projects

- Projects with construction Material Categories
 - Asphalt mix, Concrete (and cement) and steel
- Title 23 construction projects
 - Federal-aid highway, tribal transportation facility, Federal lands transportation facility, Federal lands access transportation facility
- Activities required to develop a process to demonstrate that materials:
 - Materials that meet the standard of “substantially lower embodied carbon”
 - Are appropriate for use on eligible construction projects



Performance Monitoring and Data Collection

- Data collection by using database
 - In combination with WisDOT Pavement Condition Index, data will aid WisDOT in determining if LCTM have measurable impact on long term performance.
 - Create and Maintain an EPD Database
 - Document Compliance & payment



On-going activities

- Review and enhance EPD Collection and Validation process
 - Update the EPDs
 - Re-establish the EPD thresholds if necessary
- Analyze long-term Material performance data
 - Lab testing data and field data
 - Adjustment to material specifications and SPV
- Continuously improve program to encouragement to use LCTMs

How does this benefit industry?

- Increased opportunity for innovation in material use, process improvement and performance.
- Increased opportunity for incentives for use measurable and quantifiable LCTMS
 - In addition to current incentives



Examples

- Development of EPDs
- Mix Design Improvements
 - Performance based specifications
 - Will allow for increased use of recycle materials
 - RAP, RAS, GTR
 - Warm Mix
 - Increased use of recycled material = increased savings
- Process Control Improvements for Improved EPDs
 - Plant efficiency improvements
 - Equipment efficiency improvements

Balanced Mix Design (BMD)

- Performance Related Spec
 - Not intend to relax our performance criteria
- Test methods of BMD in WisDOT
 - Hamburg Wheel Track Test (HWTT) for rutting
 - Indirect Tension Asphalt Cracking Test (IDEAL-CT) for cracking
 - Rapid Shear Rutting Test (IDEAL-RT)
- Contractors
 - Three contractors and one consultant



How does this impact Industry? (theoretical example)

- Theoretical Project Parameters
 - 2-lane, 15-ft each lane, 3 miles of HMA project
 - 4 inches of MT 58-28 mix
 - Bid price: \$100/ton
 - Meet the performance criteria
 - Total payment without incentive:\$1.18M



Potential Incentives – example

- If Global Warming Potential (GWP) in EPD is less than 72.6kg CO2 Equiv.
 - Bid item for generating EPD
 - The better the EPD the more opportunity that is created for improvement and benefits
 - Performance incentives are also applicable
 - Incremental Cost
- All LCTM eligible incentives will also be eligible to receive performance incentives.

Threshold	Top 20% Limit	Top 40% Limit	Better Than Average Limit
Kg of CO2 Equivalent (kgCO2e/t)	55.4	64.8	72.6

Incremental Cost – example

- If GWP in EPD is less than 72.6kg CO2 Equiv.
 - Bid price: \$105/ton due to using exotic materials (compared to \$100/ton)
 - LCTM will cover the incremental cost: \$59,136.00
 - The incentive, however, would NOT be built into the bid item cost. The cost of the bid item would remain the same, and the incremental cost difference would then be factored and rewarded.
 - Bid item for generating EPD
 - Performance incentives are also applicable
 - More Sustainable does not mean lower performance.

Process to improve EPD

- Examples of Processes to improve GWP in EPD
 - Invest in the plant to update equipment in order to improve efficiency
 - Continued updates to EPDs after improvement
 - Increase use recycle material content
 - More...

Recycling Materials in HMA

- Allow Reclaimed Asphalt Pavement (RAP), Recycled Asphalt Shingles (RAS), Ground Tire Rubber (GTR) in mix and Warm Mix Asphalt (WMA)

MAXIMUM ALLOWABLE PERCENT BINDER REPLACEMENT		
Recycled Asphalt Materials	Lower Layers	Upper Layers
RAP (alone)	40	25
RAS (alone)	25	20
RAS and RAP (combination) ^{[1],[2]}	35	25

^[1] When used in combination the RAS component cannot exceed 5% of the total weight of the aggregate blend.

^[2] The maximum allowable Pbr from RAS and RAP in combination in an SMA is 15%.

Partnership with industry



Thank you

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