AID-PT

Accelerated Implementation & Deployment of Pavement Technologies

INSIDE:

Floods create sinkhole, destroy highway in Colorado.
Source: Colorado DOT

Fall

NEWSLETTER

2023

U.S. Department of Transportation
Federal Highway Administration

States Join FHWA Climate Challenge to Tackle Greenhouse Gas Emissions

A coastal storm floods a section of Delaware State Route 1. *Source: DelDOT*

As the lowest-lying State in the Nation, Delaware is familiar with the effects of climate change and sea level rise on infrastructure. "We see this daily as some roads have overtopping of water due to tide and wind cycles, regardless of storm events," said Delaware Department of Transportation (DelDOT) Resilience and Sustainability Director Jim Pappas. He says these instances, also known as "sunny day" flooding events, are becoming more frequent and widespread across the State's roadway network. For Pappas, this is especially concerning because some roadways provide a single-entry point to coastal communities.

In 2021, DelDOT created a Division of Transportation Resilience and Sustainability, and the governor published a Climate Action Plan. The plan's focuses are minimizing greenhouse gas (GHG) emissions and maximizing resilience to climate change impacts. DelDOT is creating a carbon reduction pavement program to reduce climate impacts while still constructing and maintaining an efficient and effective State transportation network.

Five inches of rain on Route 40 in the Glasgow area of Delaware reduced traffic to one lane. *(Source: DelDOT)*

In 2022, FHWA announced a two-year Climate Challenge administered by the Sustainable Pavements Program. DelDOT and the Virginia Department of Transportation (VDOT) are among 27 agencies to receive funding, training, and technical assistance. Selected participants are using life cycle assessments (LCAs) and environmental product declarations (EPDs). As of October 2022, FHWA has distributed more than $7 million to the participants. DelDOT and VDOT each received $312,000.

As part of the Climate Challenge initiative, DelDOT has teamed up with the University of Delaware to train those who plan, design, build, and maintain pavements in the effective use of LCAs and EPDs; collect and review baseline environmental data; create EPDs for construction materials; track and document GHG emissions from constructions projects; and more.

Since the transportation section accounts for about 29 percent of GHG emissions in the United States, there is an opportunity to significantly impact the processes and materials used for pavement construction, maintenance, and rehabilitation. However, for agencies to develop strategies to reduce GHG emissions, they need to first measure them.

Stakeholders in the pavement community are embracing the need to adopt more sustainable practices throughout all aspects of transportation project delivery. This *video* highlights what is needed to develop sustainable pavements.

"There is a need to educate, collect open-sourced data, modify and implement GHG accounting frameworks, and disseminate findings through case studies," said VDOT Principal Research Scientist Brian Diefenderfer. "We're excited to be a part of the FHWA Climate Challenge. The funding and technical support will help VDOT to create a research roadmap, develop and deliver training, conduct LCA case studies, develop EPDs, and more."

For a list of agencies, project descriptions, and funding amounts, visit the FHWA Climate Challenge.

High standing water makes travel difficult on U.S. 101 in Tillamook, Oregon. *Source: Oregon DOT*

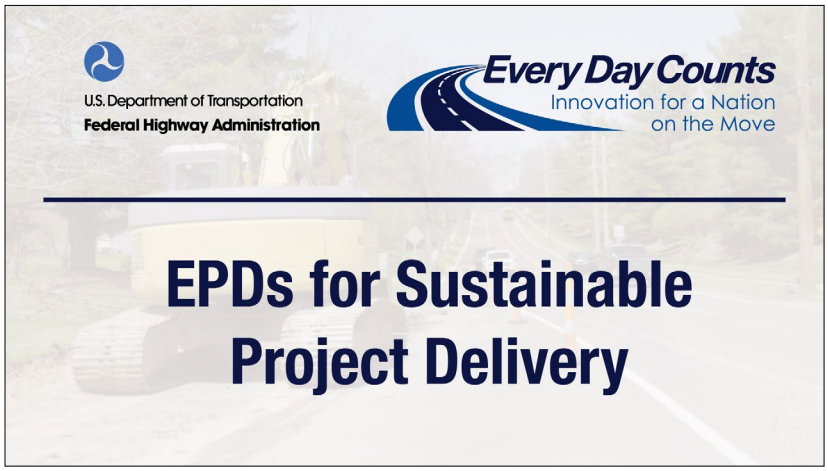
Source: Fotosearch.com

EPDs for Sustainable Project Delivery

The United States has pledged to lower greenhouse gas (GHG) emissions from 2005 levels by 50 percent by 2030 and achieve net zero by 2050. In transportation, meeting GHG reduction goals often focuses on operational carbon emissions such as tailpipe emissions. Now the Federal Highway Administration (FHWA) is shining a spotlight on reducing embodied carbon associated with manufacturing, transporting, and producing construction materials such as aggregate, asphalt, cement, asphalt mixtures, concrete mixtures, and steel reinforcement.

"We're making design, construction, maintenance, and preservation decisions that impact embodied carbon emissions," said FHWA Pavement Design and Performance Team Leader LaToya Johnson. "We need to be able to make informed decisions early in the process. We can't go back once a project is complete and reduce the embodied carbon emissions."

FHWA is encouraging transportation agencies to implement a new Every Day Counts (EDC) innovation called EPDs for sustainable project delivery. An EPD, or environmental product declaration, is a third-party verified report used to document embodied carbon and communicate the GHG emissions of construction materials in a transparent and standardized manner.



Watch this *video* to learn more about EPDs for Sustainable Project Delivery.

Industry creates EPDs to provide environmental impact information, help transportation agencies make informed decisions, encourage industry efficiency, and reduce environmental impacts.

State of Practice

The passage of new legislation in recent years has increased the popularity of EPDs. In December 2021, President Biden signed Executive Order 14057: Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability, creating the first White House Buy Clean Task Force to provide recommendations for establishing a Buy Clean Policy

for Federal agencies. After several meetings, the task force recommends that Federal agencies collect EPDs when purchasing concrete, asphalt, steel, and flat glass.

In August 2022, President Biden signed the Inflation Reduction Act (Pub. L. No. 117-169), authorizing $2 billion for a Low-Carbon Transportation Materials program. FHWA can reimburse or incentivize eligible recipients to use construction materials with substantially lower levels of embodied GHG emissions. EPDs will be used to identify low-carbon materials eligible for the program.

Increasingly, public agencies throughout the country are using EPDs to address GHG emissions. States such as California, Colorado, Minnesota, and Oregon are implementing Buy Clean policies that require EPDs to help procure construction materials with lower embodied GHG emissions.

Colorado

Colorado House Bill 21-1303, adopted in 2021, prompted the Colorado Department of Transportation (CDOT) to collect EPDs. "For States where Buy Clean legislation is being considered, DOTs should learn about the EPDs for sustainable project delivery initiative, so they are better informed," said CDOT Pavement Engineer Hailey Goodale.

Colorado's new Buy Clean legislation created a requirements timeline. In 2022, CDOT began collecting EPDs for eligible materials defined as cement and concrete, asphalt, and steel. CDOT will use information from the EPDs to benchmark and create a policy setting maximum allowable global warming potential limits for these materials by January 2025. In July 2025, all winning bidders of CDOT construction contracts must submit EPDs for eligible materials in accordance with the CDOT policy. CDOT will begin reporting GHG reduction progress to the State legislature in 2026 and will have the opportunity to review and adjust the policy every 4 years.

Oregon

The Oregon Department of Transportation's (ODOT's) experience with EPDs started in 2021 with the release of its Strategic Action Plan. The plan directed ODOT staff to set an emissions baseline through a GHG inventory and begin phasing in low-carbon materials, fuels, and best practices. ODOT's GHG inventory found that 70 percent of ODOT operations emissions come from concrete, asphalt, and steel the agency uses to build and maintain the State's transportation system.

"It is typical for any business, including a DOT, to have a majority of emissions associated with the upstream supply chain," said ODOT Sustainability Program Manager Zechariah Heck. "The production of conventional cement and steel, two of the most frequently used building materials, accounts for approximately 15 percent of global GHG emissions."

The ODOT GHG inventory project resulted in over 40 recommendations, including maximizing the use of supplementary cementitious materials to reduce GHG emissions and developing an EPD program to identify ways to reduce pavement embodied carbon.

The recommendation to develop an EPD program became law in 2022 when the Oregon House passed Bill 4139. The legislation requires ODOT to collect EPDs on asphalt, concrete, and steel by the end of 2025 and to devise two strategies to reduce GHG emissions from the materials used to construct and maintain the State transportation system.

"Sustainability is just good engineering; it's just doing the best business we can for everyone on this planet," said FHWA Sustainability Program Manager Migdalia Carrion. "I want to encourage State transportation departments and local public agencies to start collecting EPDs and understanding them so we can improve how we do business."

Contact LaToya Johnson or Migdalia Carrion of the FHWA Office of Infrastructure for information and technical assistance.

> ***"The production of conventional cement and steel, two of the most frequently used building materials, account for approximately 15 percent of global GHG emissions."***
>
> *— Zechariah Heck, ODOT Sustainability Program Manager*

Addressing Sustainability Requires all Hands on Deck

Since the creation of the Federal Highway Administration (FHWA) Sustainable Pavements Program in 2010, sustainability has become a key focus of FHWA programs, projects, policies, and processes. Recent legislation, such as the Infrastructure Investment and Jobs Act, also known as the Bipartisan Infrastructure Law, and the Inflation Reduction Act, are helping further develop plans to implement sustainability.

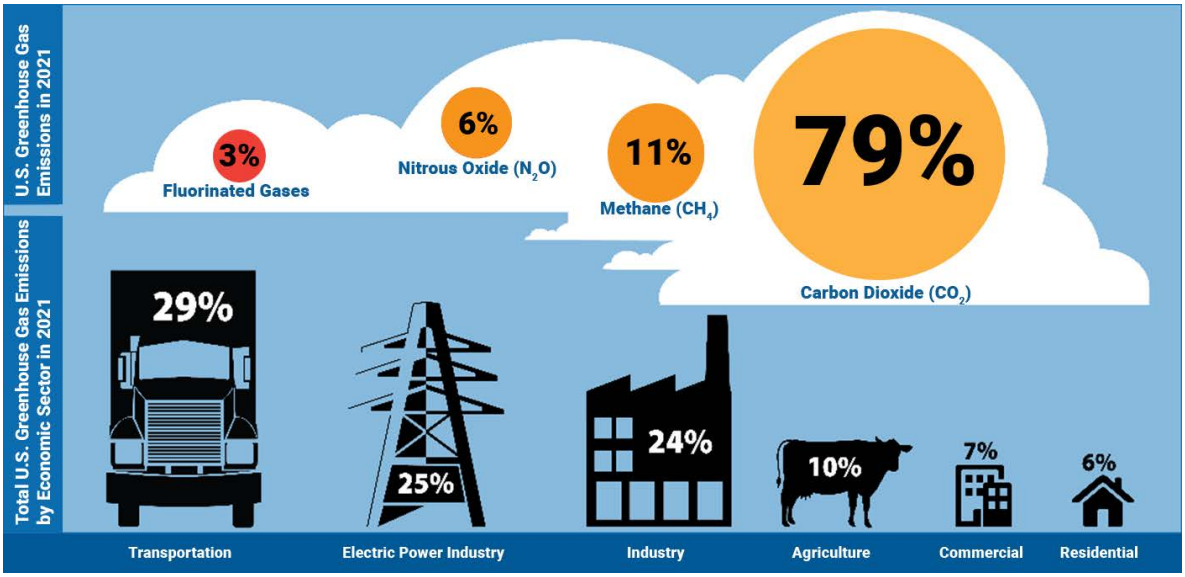
*In the past decade, the **Sustainable Pavements Program** has:*

- Created a national dialogue on pavement sustainability through more than 20 Sustainable Pavement Technical Working Group meetings.
- Evaluated the state of knowledge related to the sustainability of pavements.
- Educated stakeholders through more than 15 webinars, 30 technical documents, and 50 presentations.
- Developed a pavement life cycle cost analysis (LCA) tool.

Sustainability is often described as the balance of environmental, economic, and social needs, collectively called the "triple bottom line." "A sustainable approach to pavement projects means we will minimize environmental impacts, maximize economic benefits, and ensure equitable social outcomes," said FHWA Sustainable Pavements Program Manager Migdalia Carrion. "We're taking all the readily available information and considering all the impacts."

According to the U.S. Environmental Protection Agency (EPA), the transportation sector is the country's biggest emitter of greenhouse gases, with 29 percent attributed to tailpipe emissions. This does not account for the embodied carbon created during the production of construction materials such as asphalt, cement, and steel.

"Transportation engineers have a crucial role in decarbonizing our sector in the coming decades," said Pavement Design and Performance Team Leader LaToya Johnson. "But to do that, it will take all hands on deck. Everyone must play a part."



The EPA develops an annual report, called the Inventory of U.S. Greenhouse Gas Emissions and Sinks (Inventory), that tracks U.S. greenhouse gas emissions and sinks by source, economic sector, and greenhouse gas going back to 1990. Data in this infographic is from the 2021 Inventory. *(Source: EPA)*

"As transportation professionals, we need to do everything possible not to contribute to the problem," said Carrion. "We need to understand how our current practices contribute to the problem while ensuring we continue to deliver safe and reliable transportation infrastructure for now and in the future."

Visit the FHWA Sustainable Pavements Program website, or contact LaToya Johnson or Migdalia Carrion of the FHWA Office of Infrastructure for information and technical assistance.

States Find Success Using Higher Amounts of Reclaimed Asphalt

Since the early 2000s, State Departments of Transportation have integrated sustainability into pavement construction using asphalt pavement recycling technologies. According to the National Asphalt Pavement Association, the total estimated tons of reclaimed asphalt pavement (RAP) used in asphalt mixtures has increased by nearly 70 percent since 2009. While, on average, States use 20 percent reclaimed asphalt in a pavement project, some States, such as Florida, Nebraska, New Jersey, South Carolina, Washington, and Wisconsin, use up to 50 percent RAP.

The FHWA conducted virtual site visits to these States in 2020 to identify keys to their success. "Every State we visited documented performance," said FHWA Senior Pavement Engineer Tim Aschenbrener. "They're using RAP, monitoring it, and adjusting their specification if needed." He said the FHWA team identified four key takeaways—States follow project selection criteria, use a softer binder and additional asphalt content, and require contractors to follow their State's quality control plan.

1. **Project selection criteria**. There are a variety of rationales for the use of RAP. "You want to look at the lift locations and the traffic levels," said Aschenbrener. For example, as traffic levels decrease and depth into the pavement structure increases in South Carolina, the amount of allowable RAP increases.
2. **Softer binder**. Many States use a softer binder than usual to account for the stiffer RAP. This can be done by bumping the PG binder's low and high temperatures down, using blending charts, or extracting and grading the binder from a final mixture.

Reclaimed Asphalt Pavement (RAP) Benefits

Cost Savings

- Nebraska DOT saved $408M over 12 years.
- Illinois DOT saved $65M in 2020.

Carbon Reduction

- RAP use in 2021 saved 2.6M metric tons of Co_2e, equal to 574,000 vehicles.

Equal pavement performance

3. **Additional asphalt content**. "Some RAP is black rock, so you want to add additional asphalt to accommodate for that," said Aschenbrener. Asphalt mixtures must contain an adequate amount of virgin asphalt binder to ensure durability and performance. All participating DOTs required mixture designs performed per AASHTO M323, Standard Specification for Superpave Volumetric Mix Design, and AASHTO R35, Standard Practice for Superpave Volumetric Design for Asphalt Mixtures with a few exceptions, often specifically to increase the amount of virgin binder. Use of AASHTO M323 and AASHTO R35 is not a Federal requirement.
4. **Quality assurance**. "States who use higher amounts of RAP require a quality control plan," said Aschenbrener. "They want to know where the RAP is coming from, how it's processed, and how the quality is measured. The RAP is as consistent as the virgin aggregate stockpiles, but you must enforce it."

The performance history of RAP mixtures over the past 50 years, when properly engineered, produced, and constructed, can provide comparable levels of service as asphalt mixtures with no reclaimed materials.

"Every place we visited said there needs to be more training," said Aschenbrener. "There's a lot of information out there; people just need to be exposed to it and given a chance to ask questions and understand more."

Visit FHWA Pavement Recycling for more information, or contact FHWA Senior Pavement Engineer Tim Aschenbrener.

AID-PT

Accelerated Implementation & Deployment of Pavement Technologies

Source: New Jersey DOT

Source: New Jersey DOT

Office of Preconstruction, Construction, and Pavements
Brian Fouch Director
202–366–5915 brian.fouch@dot.gov

Pavement Design and Performance Team
LaToya Johnson Team Leader
202–366–0479 latoya.johnson@dot.gov

Pavement Materials Team
Gina Ahlstrom Team Leader
202–366–4612 gina.ahlstrom@dot.gov

www.fhwa.dot.gov/pavement

Publication Number: FHWA-HIF-23-074