From:	Diane Warner
To:	Council Clerk – Testimony
Subject:	Written Testimony NE 47th
Date:	Wednesday, March 2, 2022 10:55:53 AM
Attachments:	Written Testimony NE 47th NW Cement Council.pdf

Good Day,

Here is the record of the testimony I provided today for agenda item 147.

Thank You,

Diane Warner

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NCC
NORTHWEST CEMENT COUNCIL

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February 28, 2022

Mayor Wheeler; members of the Council

RE: NE 47th LID Assess Benefited properties

Good day Mayor Wheeler and members of the council

Thank you for allowing me to comment on the design and benefits of the NE 47th Ave LID project. I am a civil engineer and represent the Northwest Cement Council, a non-profit industry trade association educating and promoting for the use of cement and concrete in sustainable construction and transportation projects in Oregon and Washington.

The business owners along NE 47th , the City and PBOT have a long life pavement that will require minimal maintenance for decades to come. Installing pavements that are not susceptible to pot holes or shoving and rutting from heavy truck traffic and buses results in huge cost savings for the future operations and maintenance budgets of the city. The project manager Mr. Andrew Aebi, recognized that Marine Drive W, a concrete pavement built in 1992 with a pavement condition index of 100 almost 30 years later was great value to the City, and through his scoping phase using a full life cycle cost analysis for NE 47th, including construction, use, and maintenance costs he determined a rigid concrete pavement rather than a flexible pavement would also save the City operation and maintenance costs. minimal maintenance means minimal impact to residents and businesses, as well as students using the road and walkways in the future. Fewer future impacts in traffic and commuting hours is good value in both time and money. Rigid pavements such as portland cement concrete provide fuel savings and the white reflective pavement will keep the road and adjacent area cooler. using a variety of pavement materials in your transportation network also reduces your risk of future material escalation costs.

The city and PBOT is fortunate to have a savvy transportation engineer in Nicole Blanchard. Nicole's diligence in plan review and construction staging insured a smooth project timeline and secured a cost-effective pavement. Multiple scenarios were discussed regarding the subgrade and the challenge of managing the high water table in the area. Nicole's experience and design diligence will protect this pavement and subgrades from water issues. In the early 2000's, the city had an engineer named Brett Kesterson who was innovative in his roadway designs with concrete pavements and overlays. It was obvious to me during our discussions, that Nicole can continue to carry this torch for Portland's modern and innovative transportation future. I look forward to working with Nicole and PBOT on upcoming concrete pavement projects. I also encourage the City to consider specifying Portland Limestone Cement for future pavements projects to reduce the carbon footprint by at least 10%. Congratulations on a well coordinated, designed and built transportation project.

Respectfully,

Diane Warner, PE
Executive Director
Attachments: MIT Research on Albedo, Networks and Fuel Savings

The Role of Pavements in Meeting GHG Reduction Targets

CSHub Research Brief | Volume 2019, Issue 6

Untapped Potential

To meet the targets for reducing greenhouse gas (GHG) emissions set by cities and states, several solutions have been proposed including renewable energy production, subsidies for electric vehicles, and carbon taxes. However, transportation authorities have not considered the role of pavements as a means of reaching GHG targets. In fact, apart from impacts associated with materials production and construction equipment, pavements exert a substantial environmental impact by influencing vehicle fuel consumption. To better understand the overall effect of the road network on climate change, a high-level analysis is required that investigates how pavement policymaking can help reach GHG reduction targets. Different choices in the budget assigned to road preservation and repair should be considered to find the optimal contribution of the road network to GHG mitigation and meet targets.

Quantifying the Impacts of Pavements

We propose a systematic approach to quantify the climate change impact of pavement networks at the U.S state-level. The first step evaluates network conditions using an aggregated approach. To understand the current conditions, road mileage and surface types were extracted from Federal Highway Administration (FHWA) statistics considering different road classifications (i.e. expressways, highways, arterials, and collectors) for urban and rural neighborhoods. The next

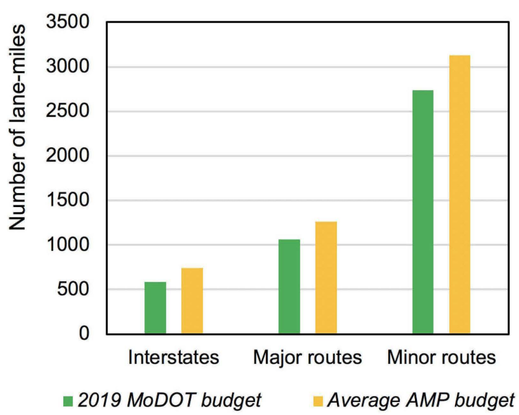

Figure 1. Missouri Department of Transportation's number of pavement lane miles repaired using the projected budget (green) versus the historical average state AMP budget (yellow).

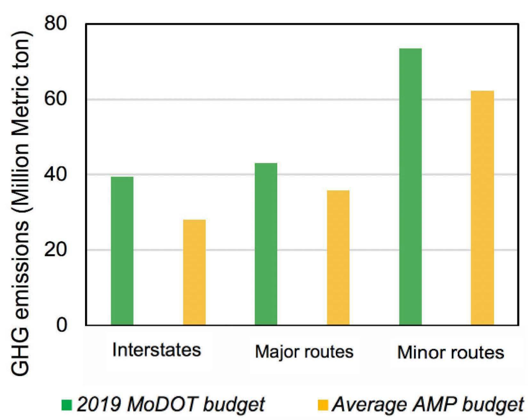

Figure 2. GHG emissions of excessive fuel consumption induced by IRI and deflection for the Missouri network with MoDOT budgets and historical average AMP budget for a 50-year analysis period.

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step involved gathering network performance data, such as international roughness index (IRI), thickness, lane number, and traffic volume, from FHWA's long-term pavement program (LTPP) database.

Then, these data were inputted into CSHub models (2,3) to estimate the future road conditions and excess fuel consumption (EFC) of vehicles from pavement surface roughness and deflection. To predict future GHG emissions associated with different road preservation and repair budget levels, researchers applied their method to a case study of Missouri's road network over a 50-year analysis period using two different budget levels (see Figure 1). The first budget level was taken from the state's historical average transportation asset management plan (AMP) budget, while the second was MoDOT's predicted 2019 budget. Additional funds enable investments in pavement treatments that can lower roughness and deflection, thereby lowering EFC.

Findings

The GHG emissions of pavements due to EFC at each budget level and for each road classification are shown in Figure 2. By increasing the budget level from the 2019 MoDOT projection to the historical average AMP values, cumulative savings would be equivalent to 1,000,000 passenger car trips of 58,800 miles each—or 29.9 million metric tons of CO2 in total. These results indicate that policymakers should consider investment in pavement repair and maintenance to reduce roughness and increase stiffness, which will mitigate climate change impacts. In the future, researchers will expand their analysis to consider the environmental impacts associated with pavement surface reflectivity and the embodied carbon associated with the materials used for reconstruction and repair of roads.

Key Take-aways

- Pavements can prove a useful tool for transportation departments to meet emissions targets by reducing the fuel consumption of the vehicles that drive on them.
- In a case study of Missouri's highway network, researchers found that increasing the state transportation budget to that of historical levels would result in significant emissions reductions.
- Researchers estimated these emissions reductions at 29.9 million metric tons of CO_2. This would be the equivalent of 1,000,000 passenger car trips of 58,800 miles each.

Learn More

For more information on CSHub pavement network asset management research, go to https://cshub.mit.edu/pavements/asset-management

Climate Change Mitigation Potential of Pavement Albedo

Research Brief, Volume 1, 2018

PROBLEM

Albedo is the measure of how much solar energy is reflected by the Earth's surface. Lighter color, or high-albedo, surfaces absorb less sunlight energy and reflect more shortwave radiation. Increasing pavement albedo has been considered as a technological strategy to mitigate impacts of climate change through a mechanism known as radiative forcing. Studies have applied simple analytical models to quantify the impact of changes in land cover on global climate. However, gaps exist in regards to quantifying the transmittance of radiation through the atmosphere and due to uncertainties with variations in time and space. In fact, the radiative forcing impact due to pavement albedo enhancement for a specific location depends largely on local radiation intensity and atmospheric conditions, which are affected by context-specific factors such as solar angle, water content, and the presence of small atmospheric particles called aerosols.

APPROACH

We developed an analytical approach to quantify global warming potential (GWP) savings due to increases in pavement albedo. The approach was adapted from a model-based parameterization *(1)* and used location-specific data on incoming solar radiation at the earth's surface and at the top-of-atmosphere (TOA), accounting also for cloud fraction as well as solar zenith angle (angle between the sun and the vertical). We used the approach to estimate GWP savings by modeling an albedo increase for all pavements in the US as a means of obtaining an upper bound on the potential of pavement albedo to mitigate the impacts of climate change. We assumed an increase in 0.2 at the beginning of the analysis period, and further assumed that the albedo change would decay to 0.1 as pavements wear off over time. We obtained data from 2016 FHWA Highway Statistics on total lane-miles of pavements by state *(2)*, and multiplied them by the corresponding GWP savings per square meter of pavement, which were calculated from our adapted location-specific model, to obtain annual GWP savings at a state level.

FINDINGS

See figure 1, page 2. As the map demonstrates, the variation in GWP savings across the country is dependent on location and climate zone, which are factors that drive context-specific RF impact. The number of lane-miles of pavements in a given state is also significant. In general, states in the southern U.S. have a larger potential for GWP savings from RF due to pavement albedo enhancement. The benefit decreases from south (for Texas 4.429 kg $CO_{2\text{-eq}}$ normalized to 1 m^2 of pavement) to north (for Minnesota 3.123 kg $CO_{2\text{-eq}}/m^2$) because pavement surfaces in northern states receive less solar radiation. Texas exhibits the greatest GWP savings (3,112 kton CO_2-eq). If all urban and rural roads in the Continental United States were converted to reflective pavements, savings would equal 34,703 kilotons in CO_2 emissions per year. According to U.S.

WHY DOES THIS RESEARCH MATTER?

- There is significant potential for pavements to mitigate the impacts of climate change.
- Evaluating the effectiveness of pavement albedo enhancement strategies (changing surface reflectivity) requires context-specific data on climate conditions, including factors such as incoming solar radiation, solar angle, and cloud cover.
- Researchers developed an approach to quantify global warming potential savings due to increases in pavement albedo

This research was carried out by the CSHub@MIT with sponsorship provided by the Portland Cement Association and the Ready Mixed Concrete Research & Education Foundation. CSHub@MIT is solely responsible for content. Authors: Xin Xu, Jeremy Gregory, Randolph Kirchain

EPA's greenhouse gas equivalencies calculator *(3)*, that's the equivalent of removing 666,381, or 8 percent, of passenger vehicles from Texas roads for one year. Nationwide, the savings would be equivalent to removing nearly 7.4 million, or roughly 7 percent, of passenger vehicles. A granular analysis at the county level greatly improves the precision of the results. Detailed results of the analysis can be accessed interactively via a Tableau workbook posted at this link.

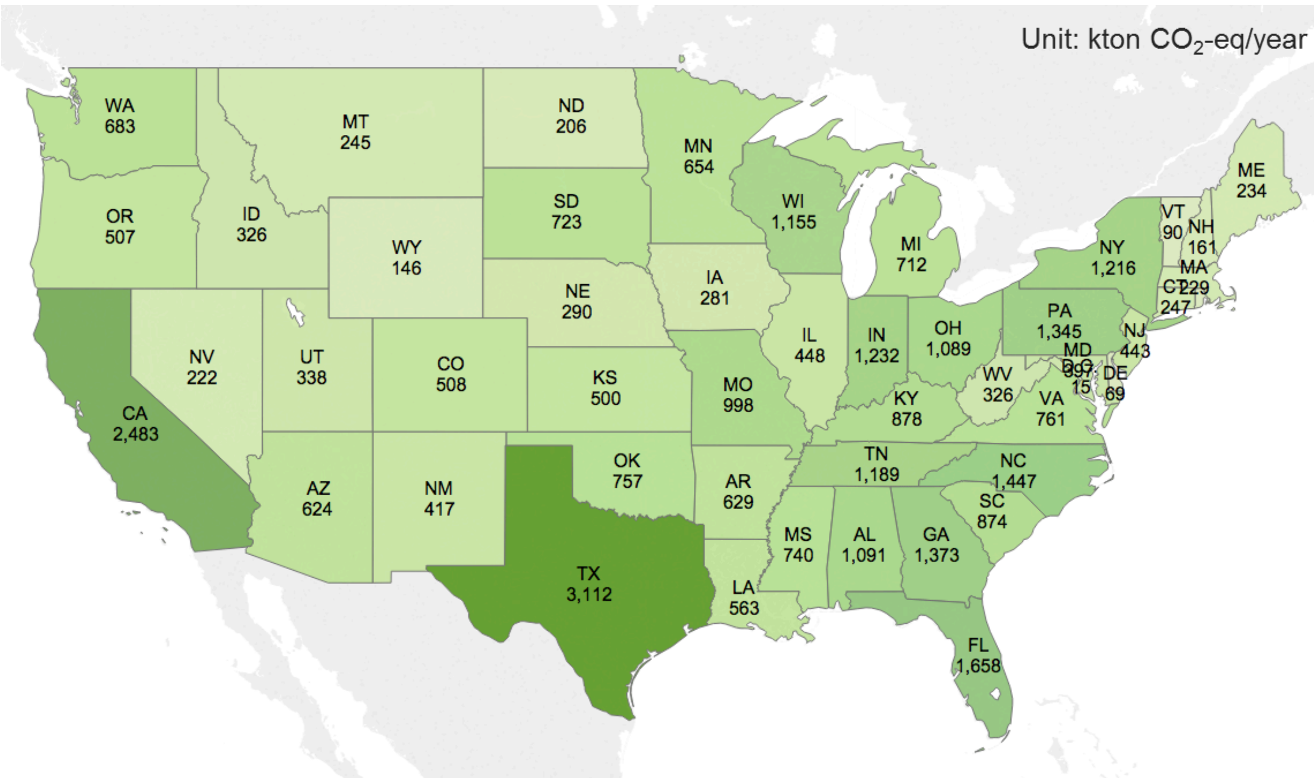

Figure 1. Annual GWP savings (kton CO_2-eq) by state from RF due to an initial 0.2 albedo increase for all urban and rural roads across the U.S.

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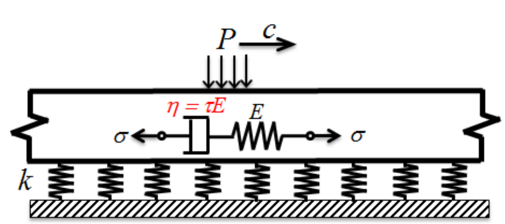
Lowering Vehicle Fuel Consumption and Emissions Through Better Pavement Design and Maintenance

Pavement-vehicle interaction and excess fuel consumption influence the fuel economy of a pavement network

- Pavement-vehicle interaction (PVI) describes the interaction between a vehicle's tires and the roadway surface it is driving on. The interaction is also known as "rolling resistance."
- Traffic patterns and the road's surface condition and structural properties determine the significance of PVI, which leads to excess fuel consumption (EFC) – wasted fuel consumption beyond what is required to move a vehicle.
- PVI factors include **roughness**, which refers to how bumpy or smooth a road is**; texture**, the abrasiveness of the road surface; and **deflection,** the bending of a pavement under the weight of a vehicle.
- Excess fuel consumption contributes to smog and greenhouse gas emissions, and costs drivers, states, and municipalities money.

MIT has developed models that quantify excess fuel consumption due to pavement-vehicle interaction for pavement segments and pavement networks

- MIT's models have been subjected to extensive peer review and validated experimentally.
- The models can be used to quantify the economic and environmental impacts of EFC in terms of costs to drivers and agencies, along with smog and greenhouse gas emissions.



Model quantifying excess fuel consumption

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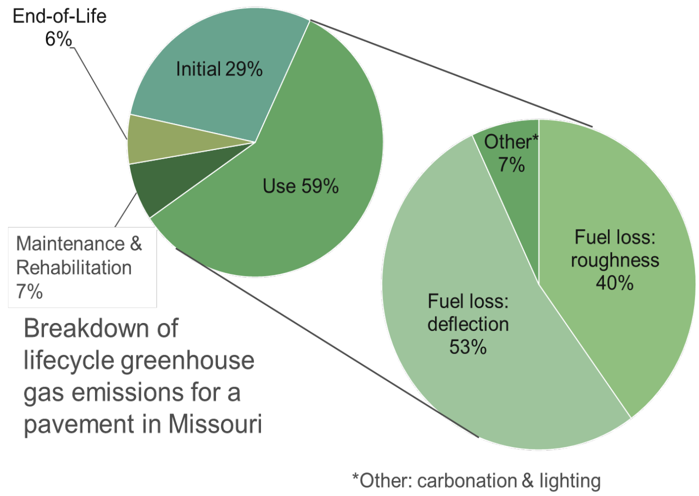
Excess fuel consumption is significant

- MIT has quantified life cycle economic and environmental impacts for a wide range of pavements and pavement networks.
- The impacts of EFC depend on the context: location, traffic levels, and pavement design and maintenance schedule.
- The analyses across a wide range of contexts have shown that it is important to consider both roughness and deflection in analyses of EFC. Roughness has a greater impact when the road is old and in need of repair; deflection is present from the beginning and depends on pavement design.

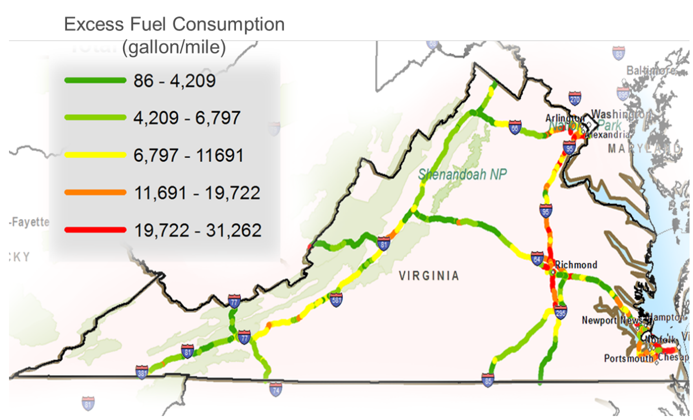


Lifecycle GHG emissions for a pavement in Missouri

- Life cycle environmental impacts due to EFC are often higher than the impacts associated with the pavement materials and construction.
- Life cycle EFC costs to drivers on a pavement segment can be millions of dollars and higher than costs due to maintenance and rehabilitation.
- An analysis of selected pavement test sections in the US calculated 700 million gallons of excess fuel consumed in vehicles annually on the sections.

Excess fuel consumption can be used to improve design and maintenance decisions

- MIT has worked with state DOTs to quantify annual EFC due to PVI in state's transportation network.
- An analysis of the pavement network managed by the California Department of Transportation (~50,000 lane-miles) identified 1 billion gallons of EFC over a 5-year period.
- An analysis of Virginia's interstate system (~5,000 lane-miles) found 1 million tons of CO_2 associated with EFC emissions over a 7-year period.



- The analyses have shown that identifying and maintaining or rebuilding a few key sections of roadways could lead to a reduction in EFC and life cycle costs.
- There are two primary strategies for decreasing the impacts of PVI: build stiffer pavements and maintain smoother pavements.
- Incorporating EFC due to PVI in pavement management systems provides a new way for agencies to maximize the performance of their pavement systems while minimizing costs and environmental impacts.

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Publication/Revision Date: October 2016

Additional information may be found at: http://cshub.mit.edu/

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City Coun i tin - Wedn sday, M r h 2, 2022 9:30 a.m.

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147.2	Jana	Jarvis
147.3	Laura	Young
147.4	Diane **L**	Warner **L**
147.5	Pia	Welch