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

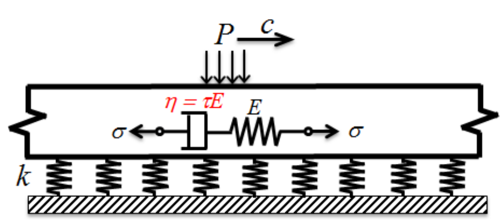
- Pavement-vehicle interaction (PVI) describes the interaction between a vehicle's tires and the roadway surface it is driving on. The interaction is also known as "rolling resistance."
- Traffic patterns and the road's surface condition and structural properties determine the significance of PVI, which 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.

PVI - Roughness

PVI-Deflection

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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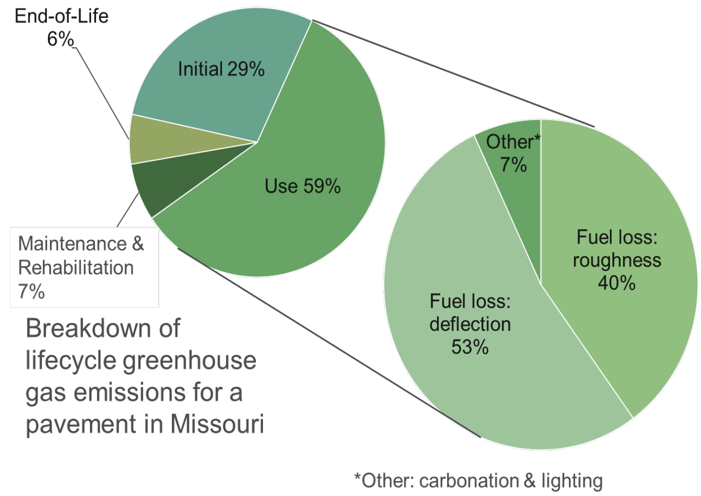
Excess fuel consumption is significant

- 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.

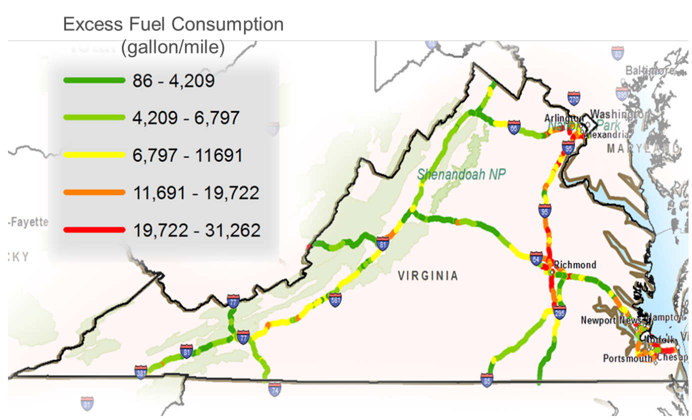


Lifecycle GHG emissions for a pavement in Missouri

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

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