Life Cycle Assessment (LCA) of Highway Pavements
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Because of the enormous environmental and economic impact of infrastructure in the United States, there is a growing need to better understand the life cycle performance of highway pavements and to investigate methods of reducing their global warming potential (GWP). It is essential to consider the full life-cycle environmental performance of pavements, including the energy and resources required to construct, maintain, and dispose of pavements over time.

In the last year, we have created a new model to quantify the life cycle carbon emissions of pavements from manufacturing to disposal. Unlike the majority of previous life cycle assessment (LCA) studies on pavements, our work includes a detailed analysis of the operating, or use, phase of the life cycle. This provides an essential starting point for both policy discussions as well as design discussions, and the results are of interest to a range of audiences.

LCA of Highway Pavements

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Focus: This study makes a comparative analysis of the carbon emissions of asphalt concrete (AC) and portland cement concrete (PCC) pavements through life cycle assessment. The goal is to quantify the carbon emissions associated with pavement material selection over a 50-year lifetime, including maintenance and differences in fuel consumption. The scope of the study is limited to high-volume pavements for highway applications, in an effort to quantify the impact of traffic volume on life cycle emissions.

Approach: The PCC and AC pavement designs include sub-base, base, and overlay layers, designed according to the American Association of State Highway and Transportation Officials (AASHTO) standards. The functional unit for the LCA consists of four lanes in each direction with a length of one kilometer. The traffic properties are based on national averages and cover fuel savings for the two main categories of passenger cars and trucks. Maintenance schedules and changing International Roughness Index (IRI) values over time are used to account for variations within the lifetime of the two pavement systems. As part of the analysis of the impact of maintenance, the associated increase in fuel consumption due to traffic disruption is also considered. The traffic level on the pavements is based on data from the Federal Highway Administration (FHWA) statistics and is divided into two main categories of cars and trucks.