DRISI
Caltrans Division of Research, Innovation and System Information

Research Results

PPRC14 SPE Sus-B: Environmental Life Cycle Assessment Updates and Applications

This research will develop additional and improved algorithms for pavement life cycle assessment for assisting in the reduction of greenhouse gases in California.

Pavement

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Project Title:
PPRC14 SPE Sus-B: Environmental Life Cycle Assessment Updates and Applications

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WHAT IS THE NEED?

The California Global Warming Solutions Act (AB 32) calls for significant reductions in greenhouse gas production by 2020. Since a significant portion of greenhouse gas production in this state comes from transportation, Caltrans needs to determine the means required to meet greenhouse gas emission targets and category pollutant regulations. Using environmental life cycle assessment (LCA) provides a robust method for determining pavement related actions for reducing greenhouse gas emissions. LCA is an approach to quantify the environmental impacts of industrial products and processes. Part life cycle assessment's value is its capacity to provide decision makers with a comprehensive perspective for considering new projects. To be able to improve the use of life cycle assessment for pavements it is necessary to develop additional and improved algorithms for the range of design, construction, maintenance, and rehabilitation strategies used in California.

WHAT WAS OUR GOAL?

The goals of this task are to improve tools for performing pavement life cycle assessment and to provide government policy makers with new insights for decisions concerning pavement projects and policy related to the reduction of greenhouse gases and other pavement related matters.

WHAT DID WE DO?

This research will develop additional and improved algorithms for life cycle assessment for the range of design, construction, maintenance, and rehabilitation strategies for assisting in the reduction of greenhouse gases in California. Questions to be addressed in the research include design life, pavement type

selection for truck lanes, continued work on analyzing Caltrans recycling strategies, regional data collection to improve California-specific life cycle assessment procedures, and support environmental product declarations and the life cycle assessment calculation processes.

It will be done by updating life cycle assessment models with new inventories, and processes; evaluating design lives, pavement selection for truck lanes, and recycling; support development of better data collection from industry and Caltrans; preparing guidelines and tools for application of LCA; and preparing the project report.

WHAT WAS THE OUTCOME?

In the second phase of life cycle assessment, called the life cycle inventory (LCI) phase, an extensive database of materials, transportation modes, and construction processes used in pavement projects in California was developed. The modeling was mostly conducted in GaBi software and models were developed with special consideration for representing local conditions in terms of electricity grid mix, energy sources, mix designs, hauling distances, and construction practices. A rigorous third party verification of the database, following the ISO 14040 requirements, was also conducted by three critical reviewers.

The cool pavement project that was conducted by Lawrence Berkeley National Laboratory is completed and an LCA tool for evaluating cool pavement strategies, called pavement life cycle assessment (pLCA), was developed and a report is completed. The tool is now ready for evaluation and will be made available to public soon. A sensitivity analysis on the output of the tool is completed and the write-up will be added as an extra chapter to the final report. As part of this project, energy consumption and greenhouse gas emissions from traffic on construction work zones (for highway maintenance and rehabilitation) is also evaluated and a report is completed. Maintenance strategies such as overlay versus slab replacement and its effect on greenhouse gas emission production and energy consumption are also quantified.

The software architectural design for a web-based tool for conducting pLCA at both project and network levels is also finalized. The comprehensive LCI database developed as part of Task 2 is used as the main source of data for the tool. Version 1.0 of the software with limited inventory of items is ready and is being internally tested for further expansion. The target audience of this tool include Caltrans, the pavement industry, and researchers from academia. The software can accept user defined LCIs and environmental product declarations (EPDs) can also be imported directly in to environmental life cycle analysis assessment pavement (eLCAP) tool by the user. eLCAP along with other tools such as RealCost for life cycle cost analysis, PaveM for pavement management, and CalME for mechanistic-empirical design of pavements, will provide a suite of integrated tools for decision-making support and optimal management of the California transportation infrastructure by Caltrans.

WHAT IS THE BENEFIT?

Emissions to air, water or land can be reduced by bringing improvements in the material production techniques, using renewable resources as energy source, using sustainable approaches, however, this can only be possible if emissions such as the greenhouse gases can be quantified. Overall, this task will help improve Caltrans pavement management and help quantify and thus, reduce the production of greenhouse gases in California. This will save the state money while helping to mitigate for climate change.