RITA Office of Research, Development, and Technology

UTC Spotlight

University Transportation Centers Program

This month: University of Maryland and Virginia Tech at the Mid-Atlantic Universities Transportation Center | December 2010

Tools to Support Greenhouse Gas Emissions Reduction—A Regional Effort

University of Maryland and Virginia Tech researchers are developing tools to reduce greenhouse gas emissions (GHG) from one of the largest sources of pollution—the transportation sector. With support from the Mid-Atlantic Universities Transportation Center, Maryland State Highway Administration, and NAVTEQ,[1] these researchers have adopted a comprehensive, regional approach to developing emission-reduction tools and bridging gaps in emissions analysis.

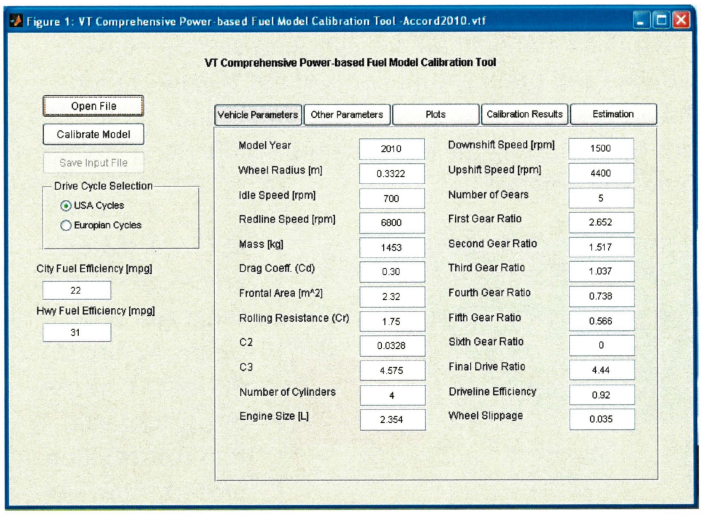
The U.S. transportation sector accounts for almost 28% of the Nation's GHG emissions. Growing awareness of the impact of these man-made emissions on climate and the environment has focused attention on developing strategies that will identify their source and magnitude. Tools for gathering this information will make it possible to develop and implement policies that support emissions reduction—with worldwide application.

Tools developed by project researchers include:

- the Comprehensive Fuel Consumption Model (CPFM), a model to help quantify the fuel consumption levels of vehicles, and develop in-vehicle technologies to reduce a vehicle's fuel consumption level;
- the Carbon Footprint Estimation Tool (CFET); and
- the Optimal Equipment Selection Problem (OESP) decision support tool.

The Comprehensive Fuel Consumption Model Tool

To support emission reductions from on-road vehicles, such as cars, motorcycles, light and heavy trucks, and buses, the project team developed the Comprehensive Fuel Consumption Model (CPFM) to help quantify fuel consumption levels and develop in-vehicle technologies to reduce a vehicle's fuel consumption.



Virginia Tech

Figure 1: Illustration of CPFM Calibration Tool

The CPFM provides two significant improvements to current fuel consumption models. First, the model produces a cruise control system that does not result in simple "bang-bang" (on-off) control. Second, the model is easily calibrated using publicly available data without a need for data collected from the field.

The CPFM was used to create an eco-cruise system to address the impact of roadway grades on vehicle fuel consumption and CO_2 emission rates. The system uses road topography data to help vehicles maintain speed and maximize fuel efficieny by allowing them to travel faster on downgrades and slower on upgrades (within a desired speed window). Savings in fuel consumption levels in the range of 10 percent were achievable using the proposed system.

[1] NAVTEQ is a global provider of maps, traffic, and location data for navigation, location-based services, and mobile advertising.

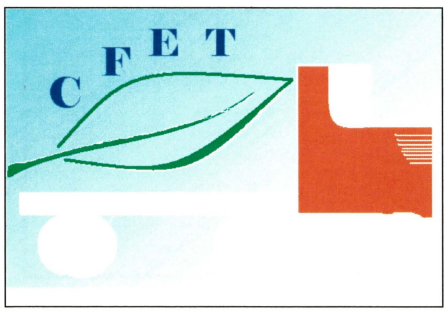
Additionally, eco-routing algorithms were developed. Routing strategies produced by these algorithms were assessed using a stochastic, multi-class, dynamic traffic assignment and simulation framework, resulting in a fuel consumption savings of about 15%.

The Carbon Footprint Estimation Tool

To support the need for emissions reduction tools for another segment involving the transportation sector (i.e., the construction of transportation infrastructure), a different set of tools, the Carbon Footprint Estimation Tool (CFET) and Optimal Equipment Selection Problem (OESP) decision support tool, was developed.

The transportation construction industry produces emissions through the operation of nonroad vehicles or heavy equipment, deforestation, the release of pollutants from on-site production, and the use of large quantities of off-gassing materials (e.g., asphalt and concrete). CFET enables the prediction of the carbon footprint of construction and maintenance projects associated with roadways and other components of the transportation infrastructure, while the OESP tool reduces overall emissions by optimizing the equipment selection for a variety of construction tasks.

University of Maryland



CFET Logo

CFET calculates emissions from all the major processes observed during the course of a transportation construction project, from site preparation to landscaping. It determines emissions from an inventory of equipment and construction processes, and credits efforts to reduce emissions through reforestation and equipment retrofit, while incorporating recent and future GHG policies on quantifying emissions.

The benefits of this tool lie in its wide applicability to a variety of users, as well as project sizes and types. Independently, this tool enables construction companies to identify sources and reduce emissions, while also allowing State agencies to monitor these companies in accordance with GHG laws.

The OESP tool provides an optimal equipment fleet mix that enables contractors to simultaneously analyze economic, technical, and environmental requirements of a project. By allowing the development of an optimal equipment-usage plan, the tool assists contractors in trading off project cost, duration, and resulting emissions in bid development and aids contractors in making green construction decisions. Moreover, it allows transportation agencies to consider emissions as a factor in assessing bids, and policy makers to set carbon price caps and penalties for noncompliance.

While these tools are geared to help emissions reduction in the U.S. transportation sector, they may also be used globally. Currently, with the establishment of the European Climate Change Program (ECCP), the European Union (EU) is also promoting transportation policies aimed at reducing the impact of transportation on climate change through better management of transportation systems and the harnessing of technology.

Collectively, this regional effort will enable individuals, responsible agencies and construction firms to predict and affect the impact of decisions and investments related to production of GHG emissions. These tools will ultimately help the transportation sector in successfully transitioning toward a greener future.

About This Project

Suvish Melanta, the principal author, is an M.S. student at the University of Maryland. The project team leader and Principal Investigator (PI) on the regional project is Elise Miller-Hooks, Ph.D., University of Maryland. Hesham Rakha, Ph.D., is PI on the Virginia Tech award. Cinzia Cirillo, Ph.D., is co-PI at the University of Maryland. Martin Pietrucha, Ph.D. (mtp5@psu.edu), is the director of the Mid-Atlantic Universities Transportation Center at Penn State's Larson Institute.