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Research



Results



Planning/ Policy/
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Project Title:

Environmentally-Friendly Driving
Feedback Systems Research and
Development for Heavy-Duty Trucks

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Environmentally-Friendly Driving Feedback Systems Research and Development for Heavy-Duty Trucks

Developed and tested driver feedback technology to
improve fuel efficiency of heavy-duty trucks

WHAT WAS THE NEED?

In the United States, approximately 70% of freight is moved by commercial trucks. In typical commercial trucking operations, fuel costs are usually one of the largest expenses, accounting for about 30-40% of the total operating cost. In California, medium- and heavy-duty trucks account for more than 20% of greenhouse gas (GHG) emissions from the transportation sector. Any strategies that reduce fuel consumption of these trucks will also reduce their GHG emissions, which can help California achieve its GHG reduction goals.

Among several strategies to reduce fuel consumption and GHG emissions from heavy duty trucks, "eco-driving" is one that has the potential to be very cost effective. Eco-driving can be defined as improved environmental performance of truck drivers, or fuel-efficient operation of a vehicle to achieve better fuel economy and lower tailpipe emissions, while not compromising the safety of oneself and other road users. The core of eco-driving programs is to provide drivers with a variety of advice and feedback to reduce fuel consumption. The advice and feedback can be provided through various means including websites, classes or training, and in-vehicle driving feedback systems.

University of California, Riverside (UCR) Bourns College of Engineering-Center for Environmental Research and Technology (CE-CERT) researchers have developed a variety of next-generation driver feedback technologies for light-duty cars as part of a three-year Department of Energy research program. These technologies include:

1. Eco-Friendly Fleet Planning
2. Eco-Routing Navigation
3. Eco-Driving Feedback
4. An Eco-Score and Eco-Ranking System



DRISI provides solutions and
knowledge that improves
California's transportation system

Research was needed to apply these technologies to heavy-duty trucks and to determine their potential at improving fuel efficiency.

WHAT WAS THE GOAL?

The goal of this project was to evaluate potential fuel savings and emission reductions from the environmentally-friendly driving feedback system for heavy-duty trucks.

WHAT DID WE DO?

In this project, the researchers adapted the Eco-Routing Navigation, Eco-Driving Feedback, and Eco-Score and Eco-Rank technologies for heavy-duty trucks, and integrated them with a state-of-the-art truck driving simulator located at UCR. They then recruited professional truck drivers to comprehensively test the technologies across a range of truck driving scenarios. By establishing a baseline of driving and then introducing the driver feedback technologies, it was possible to quantitatively measure the potential fuel and emission benefits. The tasks completed for this work are as follows:

Task 1.0 – Adapted Driver Feedback Technologies for Heavy-Duty Trucks.

Task 2.0 – Developed and Expanded the Truck Simulator Driving Scenarios.

Task 3.0 – Tested Driver Feedback Technologies.

Task 4.0 – Analyzed and Reported.

WHAT WAS THE OUTCOME?

The environmentally-friendly driving feedback system for heavy-duty trucks was tested by 22 truck driver participants, with the following results:

1. The Eco-Routing Navigation technology resulted in participants selecting the most fuel-efficient route 38% of the time,

which does not follow conventional travel behavior theories, which suggest that travelers would try to minimize their overall travel costs, a large part of which is travel time.

2. The Eco-Driving Feedback technology implementation results show that for an average driver from the group of driver participants, this technology has no adverse impact on travel time and carbon monoxide emission, while reducing fuel consumption, oxides of nitrogen emission, and fine particulate matter emission by 11%, 8%, and 8%, respectively.
3. The Eco-Score and Eco-Rank technologies were not evaluated as it would involve a long-term study beyond the scope of this research project. However, the eco-scores were calculated for all the participants in the experiment, and the results show that the Eco-Driving Feedback technology improves the acceleration score by 9%, the braking score by 7%, the speed score by 3%, and the overall score by 4%.

WHAT IS THE BENEFIT?

This research created a framework that enables drivers to improve and optimize their own driving habits, and also enables fleet managers to monitor performance and make adjustments to training and policies. Over time, it develops a database of driving conditions in the fleet's operating area, which will drive algorithm modifications to continually improve performance. This applies to any heavy-duty truck fleets, including Caltrans'. The fuel savings will help reduce operating costs of the fleet while the corresponding GHG emission reduction will help contribute to California meeting its GHG reduction targets.

Given that heavy-duty trucks travel primarily on the California freeway system, reducing fuel consumption of these trucks will also reduce GHG emission contribution from Caltrans' roadway facilities.

LEARN MORE

Project Information on National Center for Sustainable Transportation (NCST) Website

<https://ncst.ucdavis.edu/project/meta-analysis-eco-driving-feedback-research>

Final Report on Caltrans Website

<https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/f0016795-ca16-2822-finalreport.pdf>

IMAGES

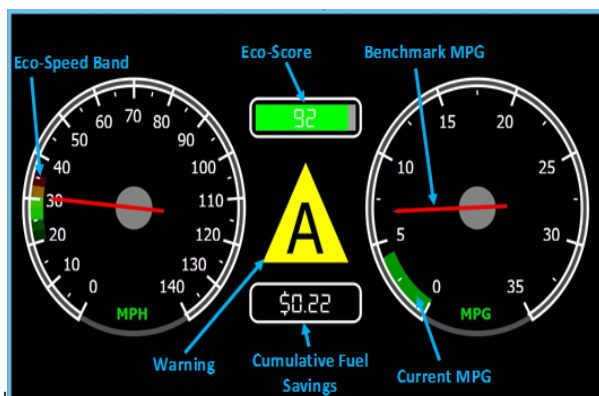


Image 1. Features of the Eco Driving Feedback technology



Image 2. A participant driving with the Eco Driving Feedback technology

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