DRISI
Caltrans Division of Research, Innovation and System Information

Research Notes

Evaluating Mixed Electric Vehicle and Conventional Fueled Vehicle Fleets for Last-mile Package Delivery

Modeling and analyzing a last-mile package delivery system, with a mixed vehicle fleet.

Planning, Policy, and Programming

NOVEMBER 2022

Project Title:
Evaluating Mixed Electric Vehicle and Conventional Fueled Vehicle Fleets for Last-mile Package Delivery: Modeling and analyzing a last-mile package delivery system, with a mixed vehicle fleet

Task Number: 3455

Start Date: January 1, 2022

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WHAT IS THE NEED?

The demand for package delivery increased dramatically in the past few years, especially during COVID-19 quarantines and subsequent periods in 2020 and 2021. Package delivery activities contribute considerably to total human carbon footprint in California. Hence, the State of California is attempting to reduce Greenhouse Gas (GHG) emissions in transportation by requiring the use of zero-emission vehicles (ZEVs) in the freight sector.

The California Air Resource Board (CARB) aims to reach the goal that the operations of all medium- and heavy-duty vehicles are zero-emission by 2045. Freight companies are taking initiatives to electrify their fleets to reduce GHG emissions. However, the process of electrifying freight delivery fleets is a long-term task, and freight companies can expect a long period of operation with a mixed fleet of electric vehicles (EVs) and conventional fuel vehicles (CFVs).

WHAT ARE WE DOING?

This project will develop a modeling and analysis approach to make more effective and to assess: 1) the mix of EVs and CFVs in a last-mile package delivery service fleet, and 2) the vehicle routes of both EVs and CFVs providing last-mile package delivery service.

WHAT IS OUR GOAL?

The goal of this project is to test and analyze a last-mile package delivery system, with a mixed vehicle fleet.

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WHAT IS THE BENEFIT?

This project will help California to reduce GHG in transportation. It will help CARB achieve its goal that all medium and heavy-duty vehicles are zero-emission by 2045. It will also assist freight companies with information on how to mix their fleet to reduce GHG emissions.

WHAT IS THE PROGRESS TO DATE?

We have completed the literature review. We also finalized the mathematical formulation for the problem of assessing packages to vehicle type, and routing these vehicles to drop off packages. We then verified and validated the model using the Pylon code and Gurobi optimization solver.

We generated problem instances that performed analyses that will inform the original study objectives. Then, we have extended the study areas to the entire LA County and Orange County region. We used mathematical models for delivery vehicle routing, considering maximum vehicle ranges for EVs and gasoline vehicles. We collected the necessary data and coded the simulation module to implement the proposed expanded case study. The next step is to code, model and solution algorithms.

IMAGES

Image 1: Electric delivery truck