Sustainable Freight Research for Accelerating Medium-Duty & Heavy-Duty Zero-Emission Vehicle Deployment

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Reducing emissions from trucks is critical

- **7.5%** of total U.S. GHG emissions come from medium-duty & heavy-duty trucks

- **31%** of total NOx emissions in California are from these trucks
  - Public health impacts are higher near freight facilities

Port drayage is an ideal early application for BETs

- Run **limited daily distance**
- **Return to home base** every night
- Spend a large amount of time **creeping** and idling
- Tend to operate in **environmental justice communities**
There are many operational barriers to the adoption of battery electric trucks (BETs)

- **Range** is relatively short
  - 250 miles for commercially available model

- **Charging time** is too long
  - 90 minutes or longer

- **Charging infrastructure** is very limited
  - Public charging stations almost non-existent
Several technological solutions can help

• Zero-emission trucks with longer range

• Faster chargers to cut down charging time

• New charging technologies that enable more opportunities for charging

• Advanced fleet management tools that consider unique characteristics of BETs

We are studying innovative opportunity charging

• Provide opportunity charging **where and when BETs would normally idle** such as queuing at terminal gates and loading/unloading at warehouses
  – Reduce deadhead miles
  – Keep BET productivity high

• Analyzing **real-world operation data** of drayage trucks serving Ports of Los Angeles & Long Beach
Preliminary results are promising

- **14%** of operating time is spent in extended idling areas (red polygons)

- **84%** of the tours can be completed if trucks receive wireless charging in these areas
  - **79%** without wireless charging
BET fleet requires new way of dispatching

• **Scheduling & dispatching** algorithms that accounts for driving range and charging needs, among other operational factors (travel time, cargo weight, service time window, etc.)
Refueling (charging) becomes more complex

- BET charging management that optimizes usage of charging infrastructure (and distributed energy resources, if any) in coordination with truck schedules
Knowing driving range becomes more important

• **State of charge (SOC) prediction** tools that account for real-world impact of many factors
  – Weight carried
  – Road terrain
  – Traffic condition
  – Weather condition
  – Driving behavior
  – Etc.
Truck Eco-Routing can save fuel (or electricity)

- 15% fuel savings on some trips with minimal impact on travel time
  - Translated to extended range for BETs

Two identical trucks used in the field experiment

Two alternative routes for the same trip
More research is needed

• **Supporting technologies** for BET operations
  – Scheduling & dispatching
  – Charging management

• **Charging infrastructure deployment** for BETs
  – Transportation and electrical grid network integration
  – Public-private partnership

• **Public health and other benefits** of truck electrification
  – Ensuring equitable deployment of BETs and charging infrastructure
  – Protecting against unintended consequences
Thank You

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