Empire Clean Cities

CALSTART

CLIMATE WEEK NYC: ELECTRIFYING MDHD VEHICLES WEBINAR

AGENDA

- Introduction
- CALSTART: DOE MDHD EV Data Collection Study Presentation
- ECC: Fleet Interview Summary
- Q&A

WHO ARE WE?

Empire Clean Cities is a New York based 501(c)(3) not-for-profit environmental organization committed to ensuring clean air for future generations by providing citizens and stakeholders with reliable information about alternative fuels and advanced vehicle technologies.

Mission Electric is our Electric Vehicle Campaign and online resource hub, providing information about electrified transportation to car buyers, fleets, and micromobility users about the benefits of going electric in New York State.

OUR TEAM

Joy Gardner
Executive Director

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Community Engagement Manager

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Policy and Partnerships Manager

David Chernack
Program Manager

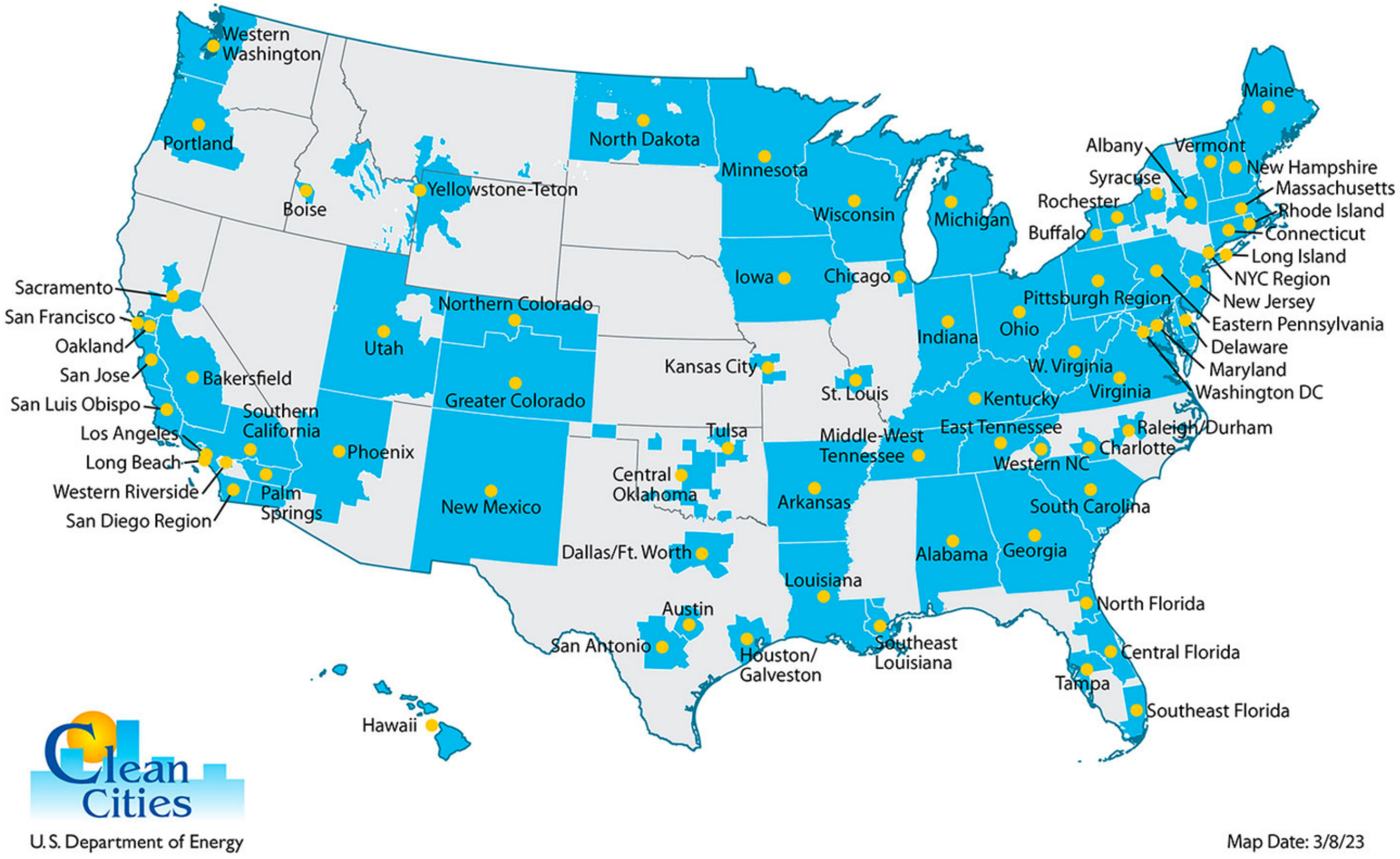
Lara Calkivik
Communications and Outreach Coordinator

Zanasia Graham
Mission Electric Coordinator

WHAT WE DO

- Provide **education and outreach** to decision makers, fleets, and the public
- **Offer AFV planning support**, training, and access to technical assistance
- **Connect fleets and municipalities** with alternative fuel providers, industry partners, and resources
- **Identify funding** and incentive opportunities
- **Collect and analyze** regional data
- Support Alternative Fuel **Corridor planning**

ABOUT CLEAN CITIES



Clean Cities
U.S. Department of Energy

- **ECC is the designated U.S. Department of Energy's designated Clean Cities Coalition for NYC** and the Hudson Valley.
- The Clean Cities program—celebrating 30 years!—is **made up of a national network of more than 75 local coalitions.**
- Clean Cities Coalitions provide access to data, information and a vast network; competitive funding opportunities; and support from US DOE and National Labs.

DOE MHD EV Data Collection Project

Medium- and Heavy-Duty EV Performance Analysis

Mark Hill
CALSTART

Empire Clean Cities Webinar
September 20, 2023

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Using data to address the knowledge gaps

Improving the public understanding of current deployment of MHD EVs is essential for accelerating EV adoption

Project objective

- Collect, validate, analyze and provide summary results on operational data collected from 200 MD and HD EVs.

Desired impact

- Expanded national EV dataset to better inform future policy and deployment decisions
-
- Identification of regional and national trends in MHD EV deployment and operating performance

Timeline

Start date: October 2019

End date: September 2023

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Northeast MHD EV Data Collection

Fleets Description and EV Utilization

EV Fleets Description

Fleet	Number of EVs collecting data	Locations	Vehicle types	Make and Model Year	Nominal Range (mi)	Rated Energy (kWh)
MANHATTAN BEER DISTRIBUTORS	4	New York, NY	Class 8 tractor	Volvo VNR 2021	120	264
PITT OHIO SUPPLY CHAIN • GROUND • LTL • TL	2	Cleveland, OH	Class 7 box truck	Volvo VNR 2022	150	264

EV Utilization:
Days in use / Days in data collection

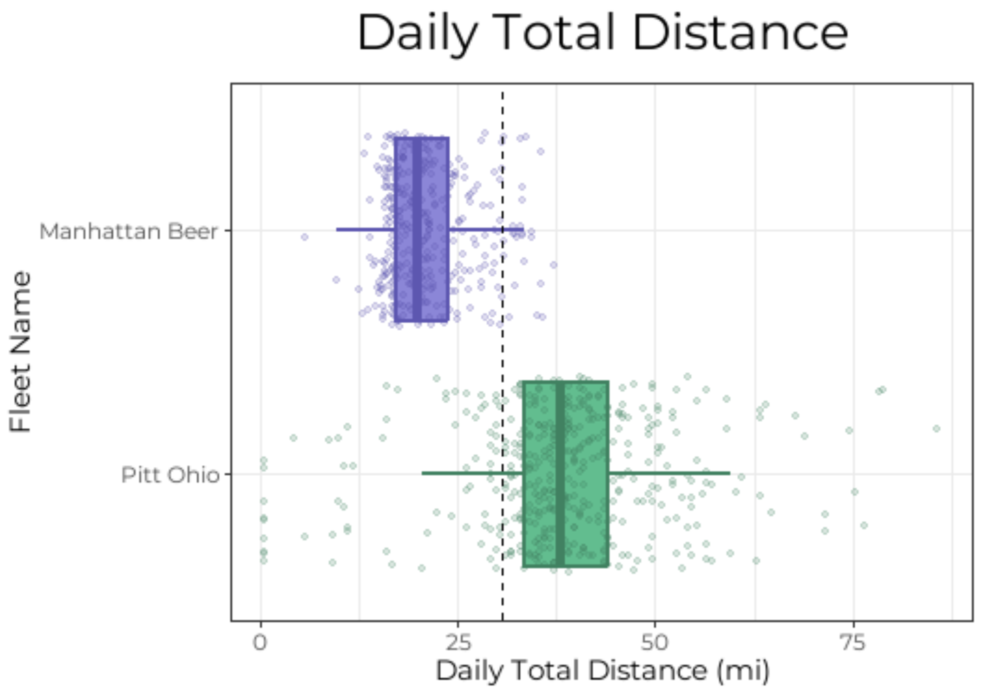
Fleets	Number of EVs collecting data	Vehicle-days in operation	Total miles driven	Vehicle Utilization Rate	Calendar Days in Data Collection	Start date	End date
Manhattan Beer Distributors	4	355	7,481	44-72%	148 (0.4 years)	2023-01-03	2023-05-31
Pitt Ohio	2	440	16,950	40-55%	470 (1.3 years)	2022-05-16	2023-08-29

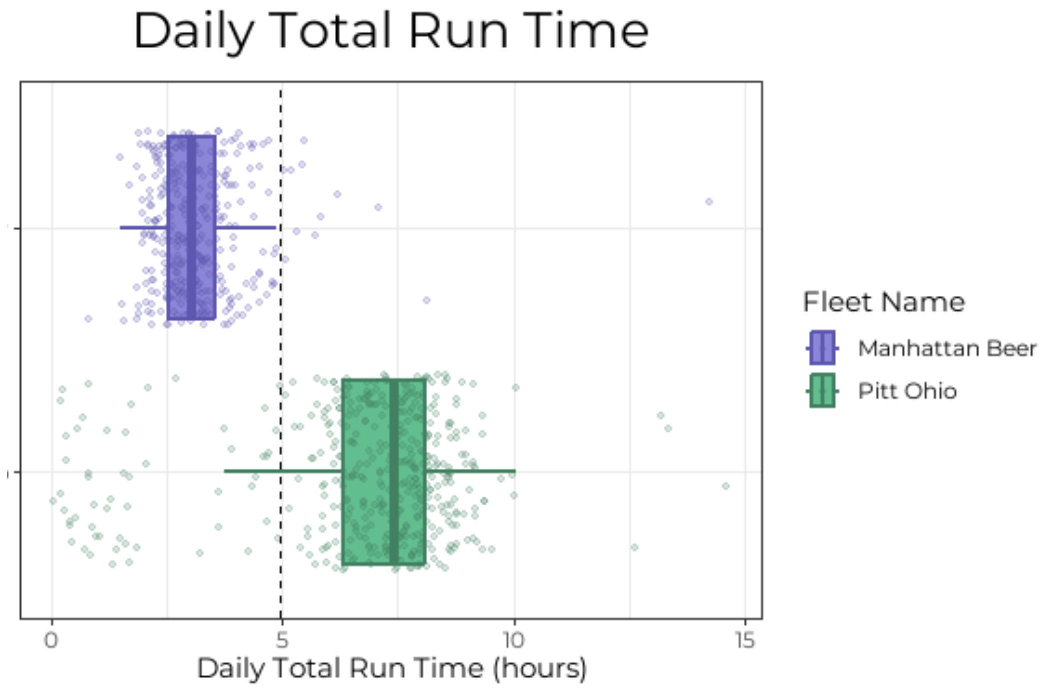
Electric Truck Duty Cycles and Energy Use

Duty Cycles Overview

	MB	PO
Avg. daily distance (mile)	**21** (**18%** of nominal range)	**39** (**26%** of nominal range)
Max. daily distance (mile)	**37** (**31%** of nominal range)	**86** (**57%** of nominal range)

	MB	PO
Avg. daily key-on time (hour)	3.1	6.8
Avg. daily driving time (hour)	2.5	4.5
Avg. daily idling time (hour)	0.6	2.3

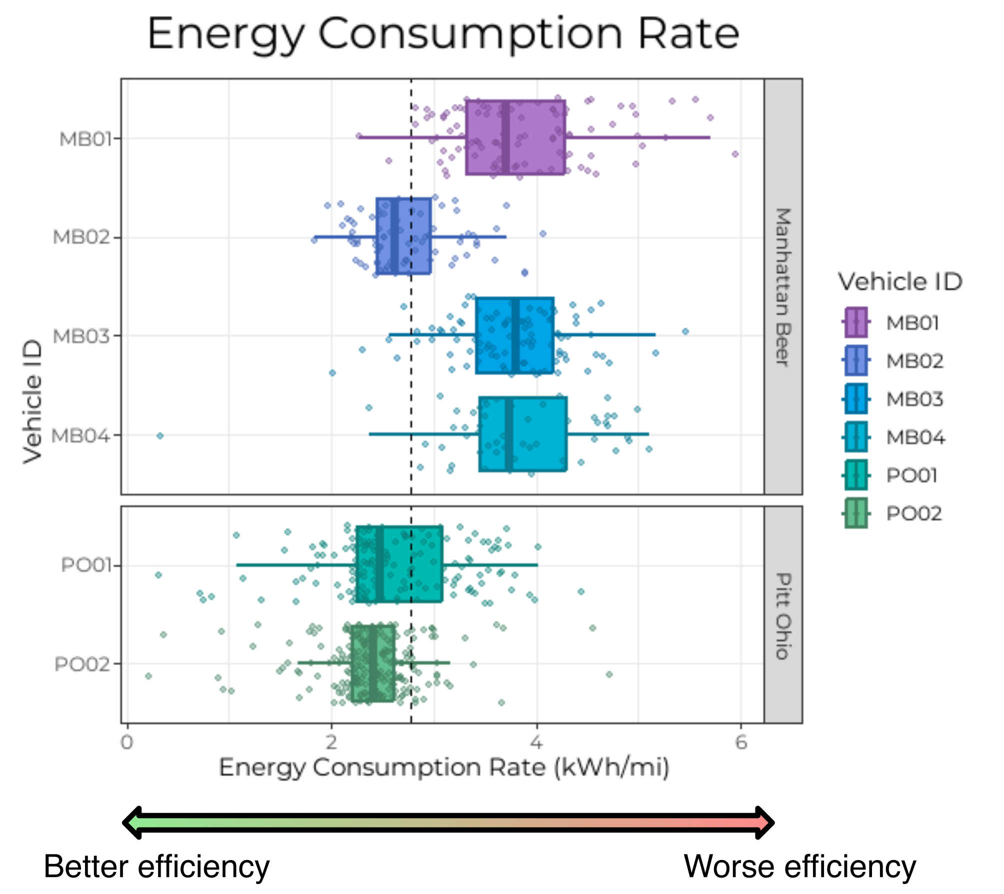




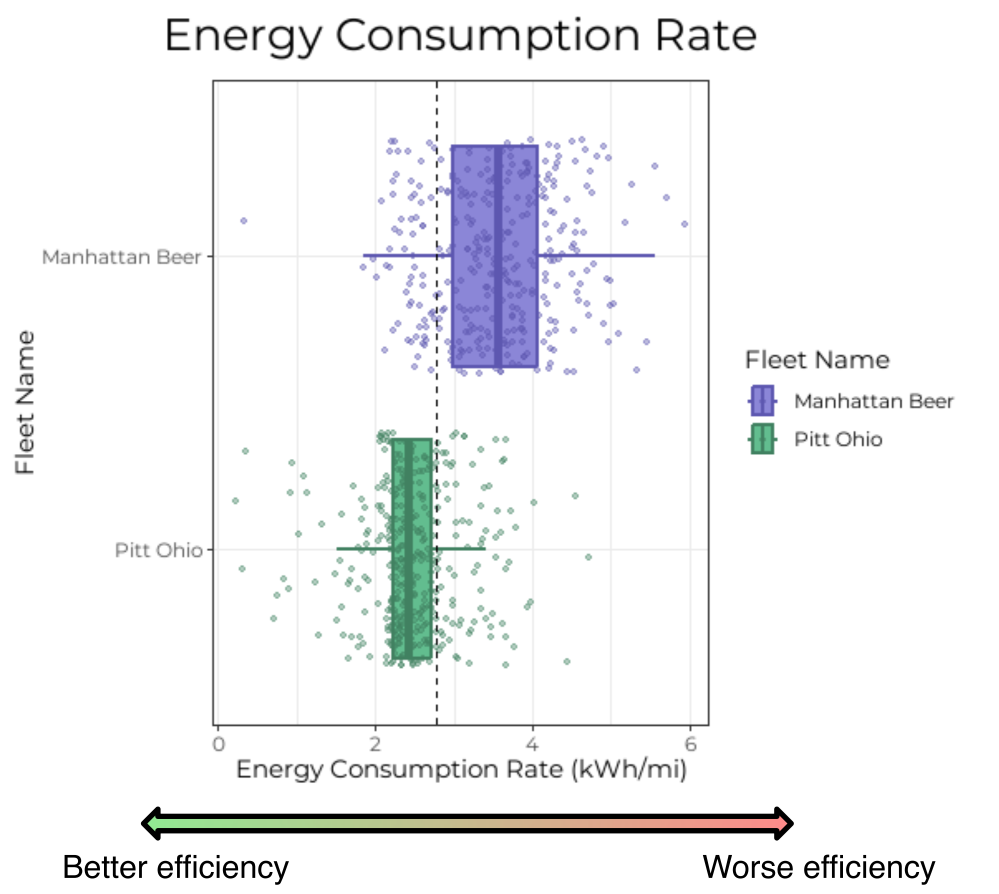
Energy Use per Mile

On average, used 3.6 kWh per mile, while used 2.6 kWh per mile

By Vehicle



By Fleet

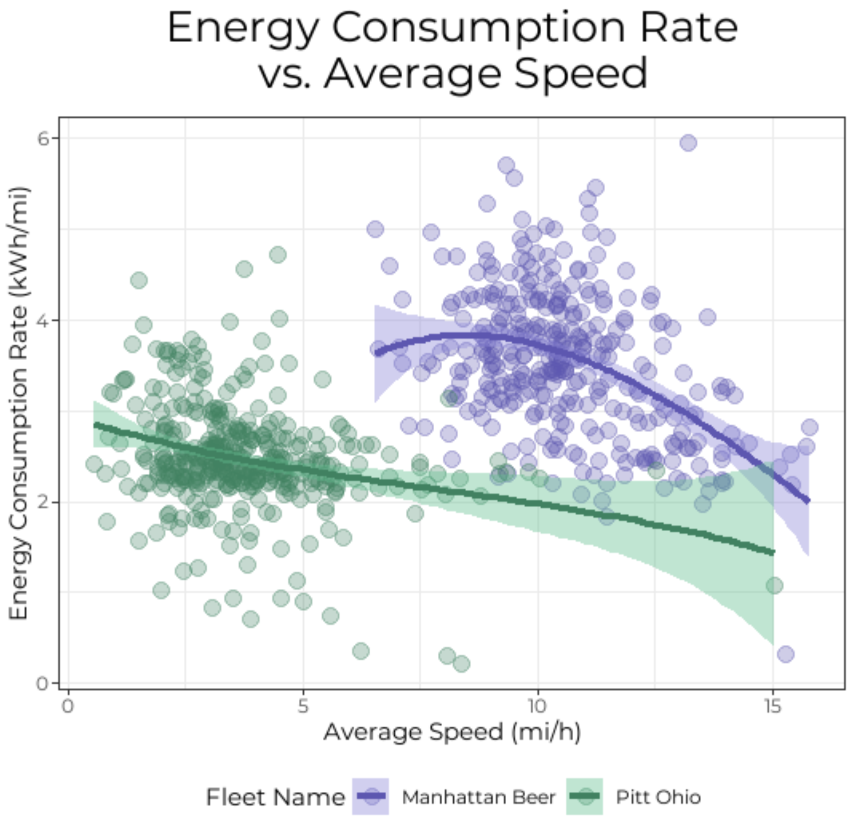


Energy Use per Mile

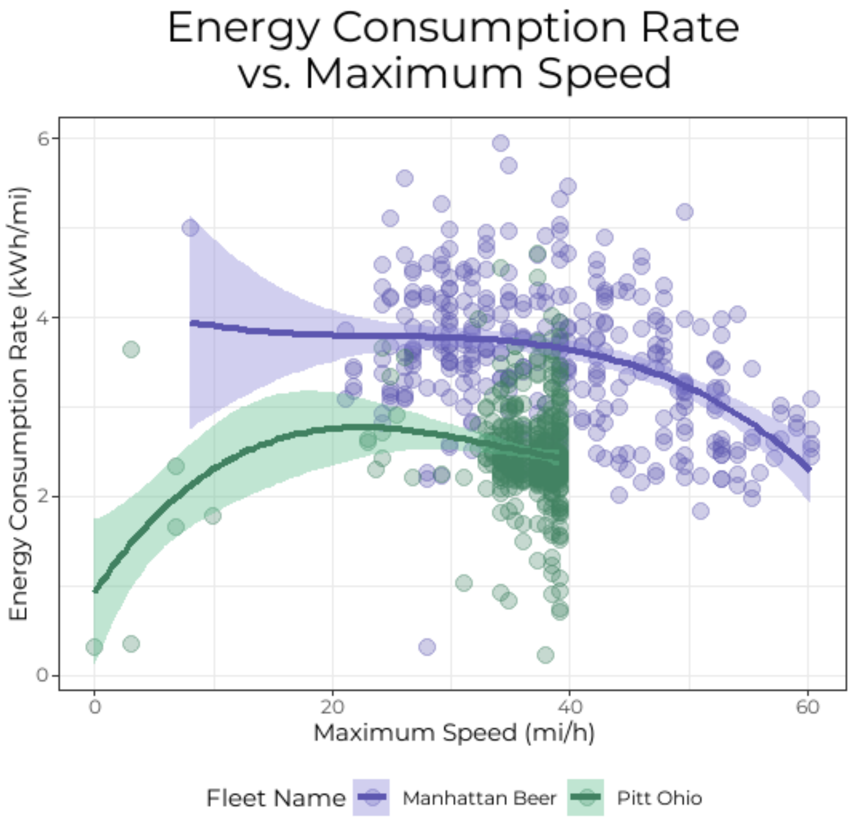
Worse efficiency

Better efficiency

Effect of Average Speed

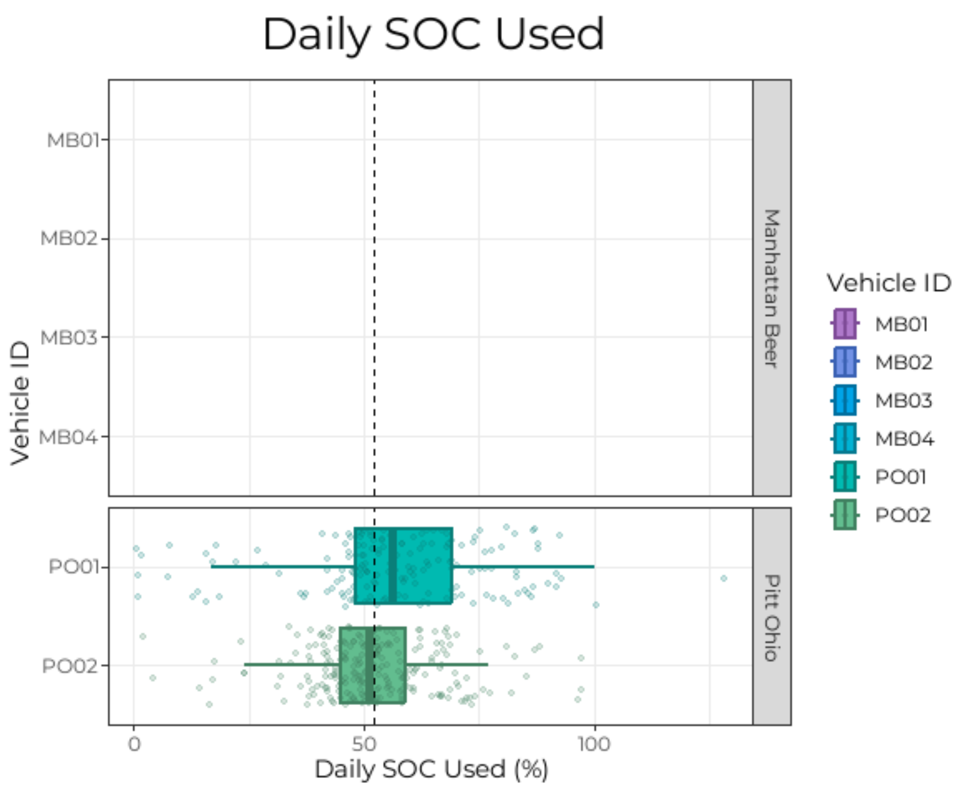


Effect of Maximum Speed

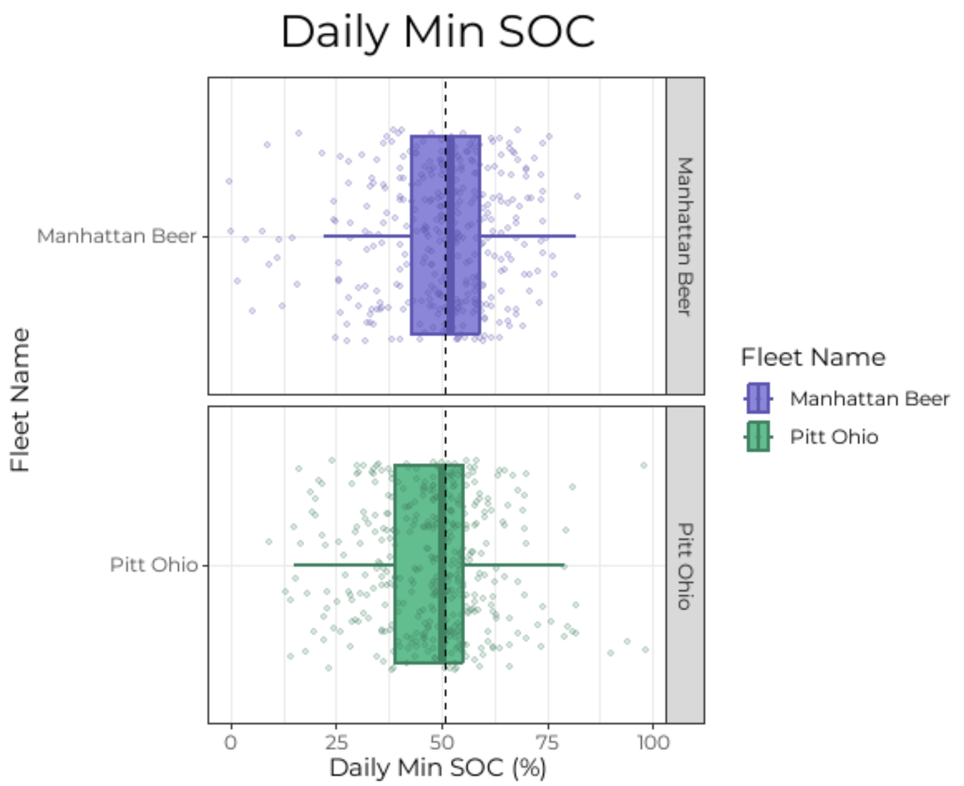


State of Charge (SOC) Use

Pitt Ohio trucks used 52-57% of their SOC per day, on average.



Trucks from both fleets reached an average daily minimum charge of 48-50%.



EV Operations and Maintenance

Survey from fleet managers, drivers and mechanics

Challenges in Operations & Maintenance

PITT OHIO
SUPPLY CHAIN ▪ GROUND ▪ LTL ▪ TL

- **Downtime:** caused by supply chain issues and difficulties ordering parts. 70-75% uptime for the chargers and vehicles.
- **Payload limitations and range:** EVs' payload limited to 8,000-10,000 pounds (range: 100-110 miles); conventional trucks' payload is 11,000-15,000 pounds (range: 200 miles). Fleet has been tweaking the payload to see how far they can push the vehicles.
- **Climate impacts:** energy use increase estimated at 7% during the mild winter; cooling fans in the summer created more noise in the EVs.
- **Maintenance needs:** Volvo insisted on doing all maintenance, but the fleet would prefer to eventually be able to maintain the vehicles themselves.
- **Issues:** contactor boxes that failed, chafed high voltage cabling that had to get addressed; HVAC complications; non-high voltage batteries issues caused by programming update.

MANHATTAN BEER DISTRIBUTORS

- **Downtime:** largely due to issues with charging; rare for the vehicles to be down due to their own hardware or software issues.
- **Payload limitations and range:** EVs' payload capacity similar to CNG and diesel trucks, but shorter routes due to limited range (up to 120 miles) mean they rarely carry at their full potential capacity; trucks drive mostly in urban NYC setting.
- **Climate impacts:** battery conditioning during hot weather can cause the truck batteries to discharge over the course of a week, even while stationary; heating the cabin draws a lot of excess battery during the winter.
- **Maintenance needs:** Volvo handles most maintenance due to high-voltage batteries, but the fleet intends to bring on dedicated EV technician(s) in the future.
- **Issues:** wish that HVAC system was a bit stronger and range was a bit longer; most issues related to the reliability of depot chargers.

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EV Efficiency Performance

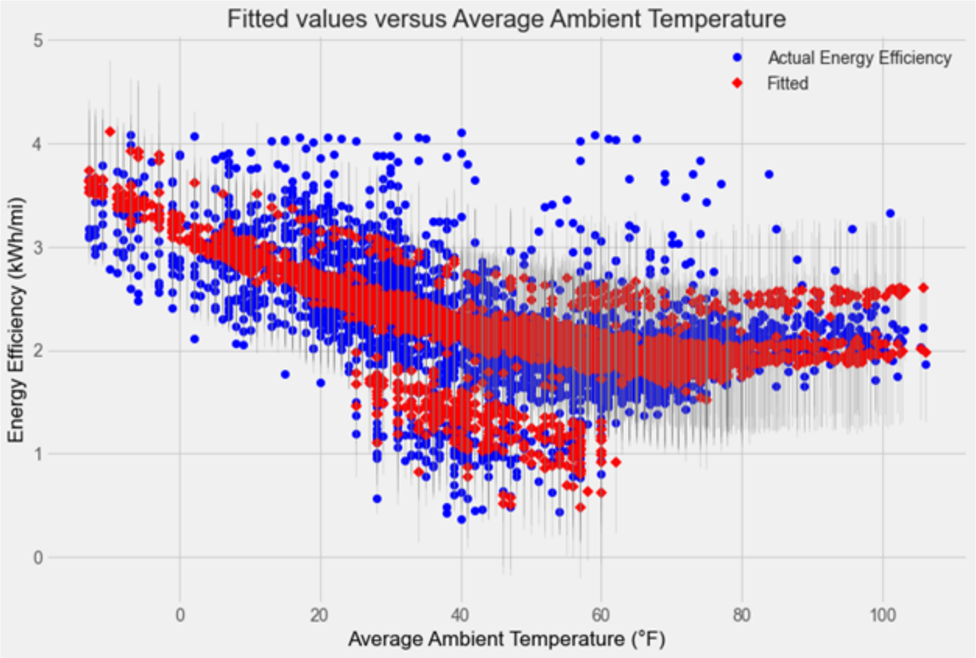
Impact of ambient temperature

Nationwide - Stronger impact on efficiency in colder climates

Transit Bus

Ambient Temperatures	Change in Energy Consumption per 100 miles
Extreme Cold Climates 0°F (-18°C) to 29°F (-2°C)	1°F ⬇ 2-3 kWh ⬆
Cold Climates 30°F (-1°C) to 55°F (12°C)	1°F ⬇ 1-2 kWh ⬆
Mild Climates 56°F (13°C) to 78°F (26°C)	1°F ⬇ 0.1-1 kWh ⬆

The optimal ambient temperature for transit bus efficiency is around 81°F (27°C), holding other variables constant.



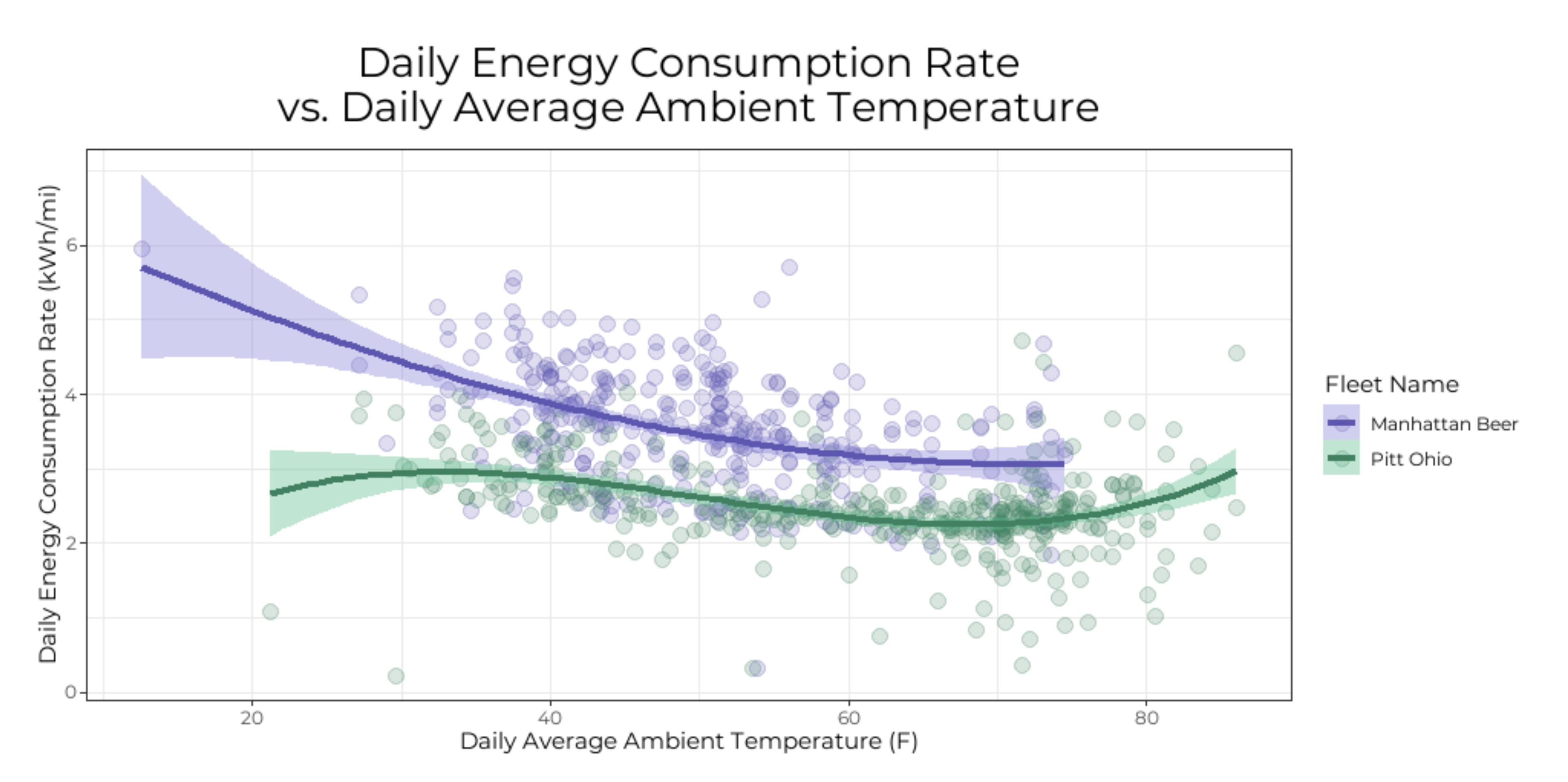
$$Energy\ Efficiency = \beta_0 + \beta_1 Average\ Ambient\ Temperature + \beta_2 (Average\ Ambient\ Temperature)^2 + \sum \beta_i Region_i + \sum \theta_j Control_j + \varepsilon$$

Northeast Electric Trucks:
Effect of temperature on vehicle efficiency

Electric trucks perform the best at mild (70-80 degrees) temperatures and worse at cold (lower than 50 degrees) and hot (higher than 90 degrees) temperatures.

Worse efficiency

Better efficiency



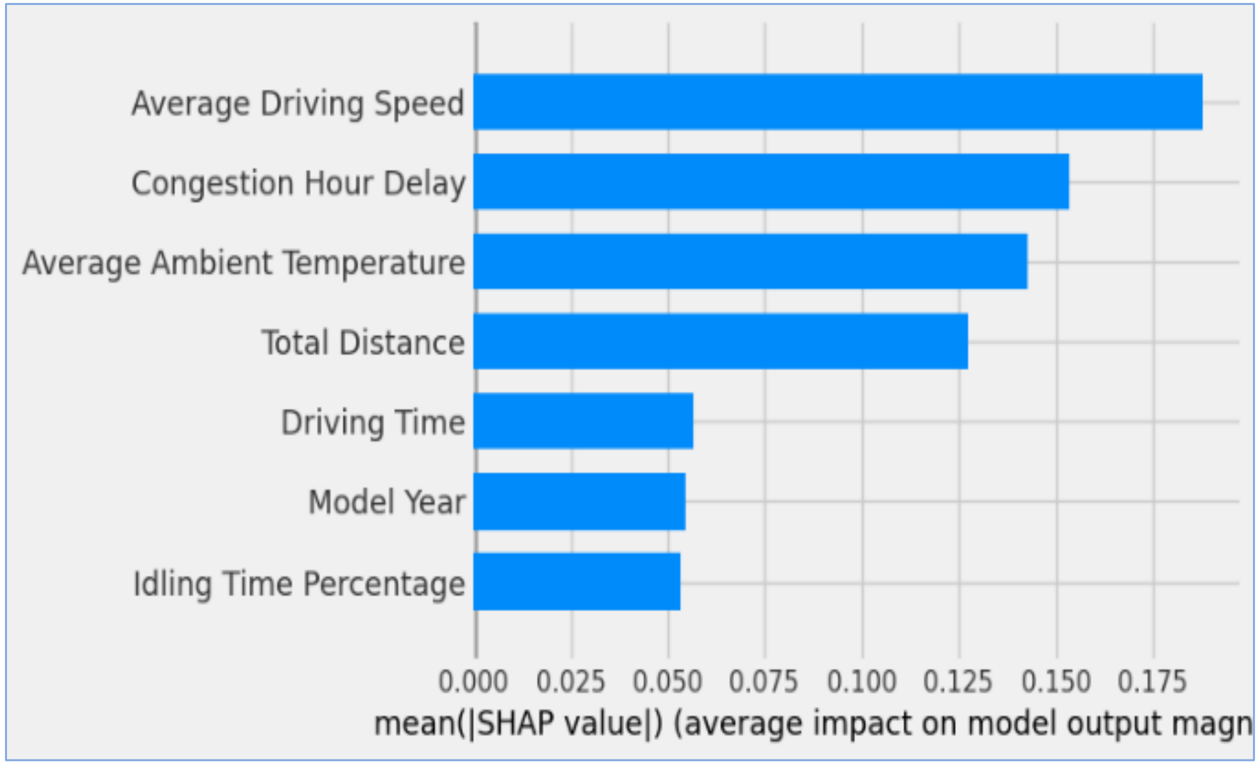
Highlights of National Findings (EVS 36 conference paper)

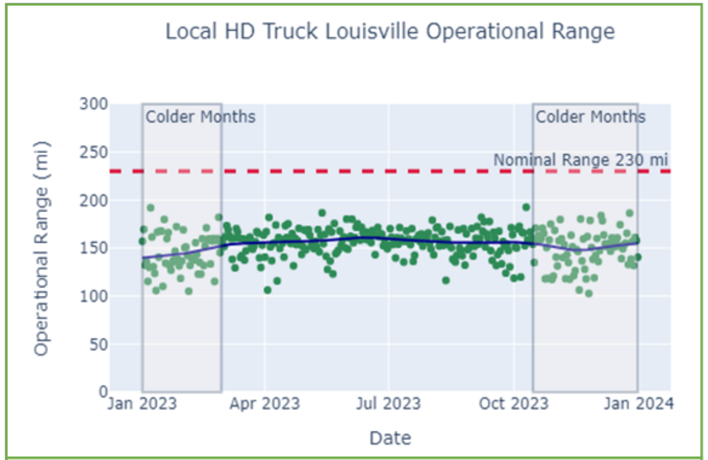
- **Operational Range Forecast**
- **Energy Cost Savings**

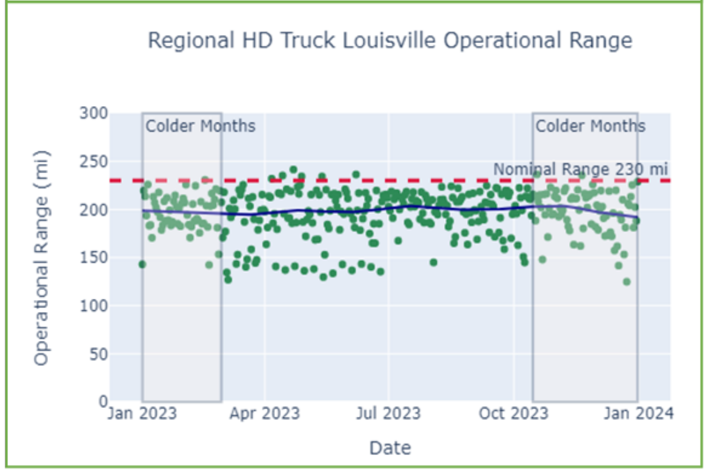
Machine Learning Predicted Operational Range

Local haul (< 100 mi) duty cycle may deploy trucks with a nominal range double the expected daily range to meet extreme conditions.

Among over 20 features to predict operational range, below are the top features.



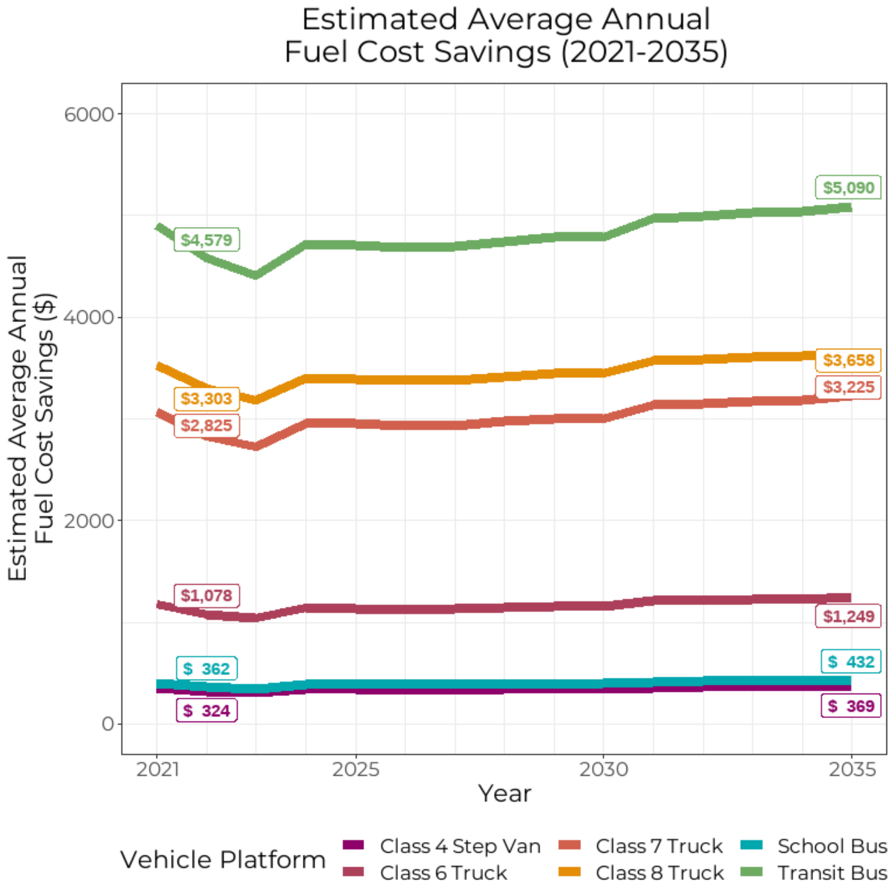




Energy Cost Savings

MHD EVs performed <u>3-6 times as efficiently as</u> their diesel counterparts. Greatest energy cost savings are seen in transit bus and HD truck, especially those with high-mileage duty cycles.

Vehicle Type	Vehicle Platform	Average EV Energy Efficiency (MPDGe)	Average Baseline Fuel Economy (MPDG)	Energy Efficiency Ratio (EER)
MD Truck	Class 4 Step Van	34.2	9.04	3.8
	Class 6 Truck	28.2	8.21	3.4
HD Truck	Class 7 Truck	18.6	4.40	4.2
	Class 8 Truck	20.1	3.56	5.7
Bus	Type C School Bus	27.4	7.06	3.9
	35–40 ft Transit Bus	20.1	3.83	5.2



Average VMT per year

Transit bus: 8,717 mi

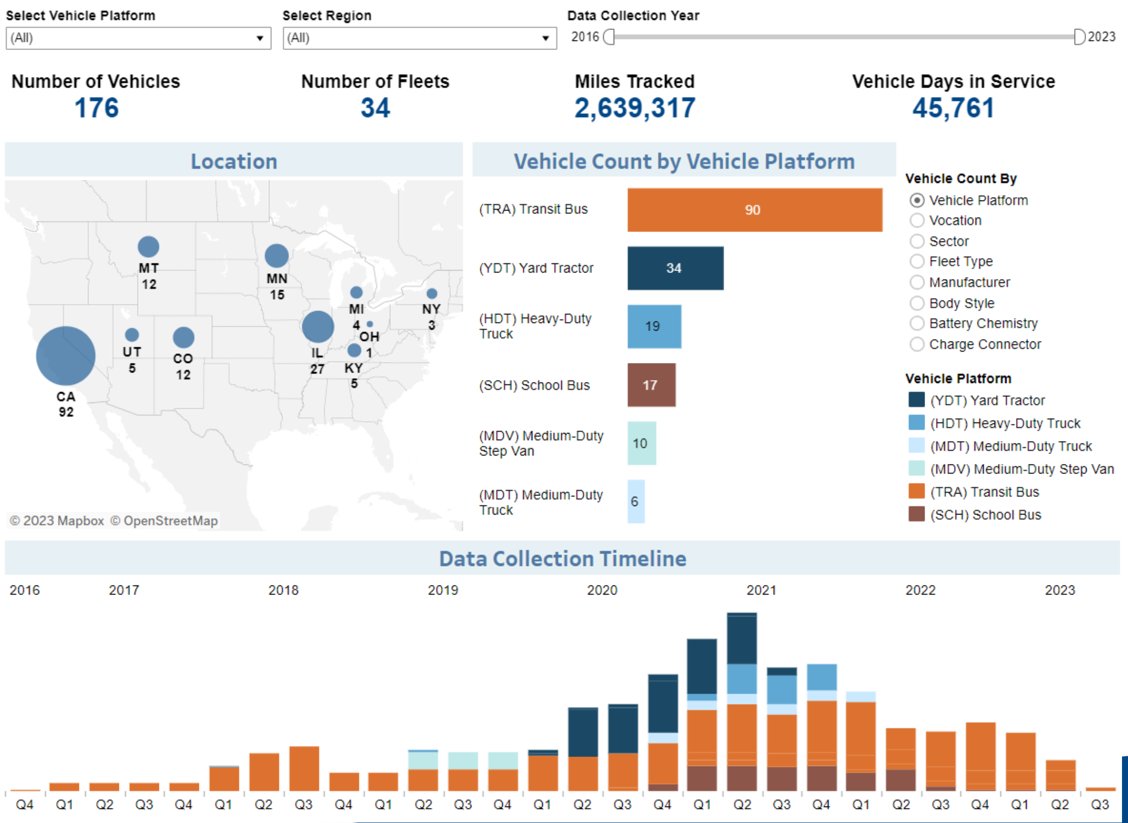
HD truck: 5,817–7,412 mi

MD Truck and School Bus: 1,663–5,547 mi

Project Resources

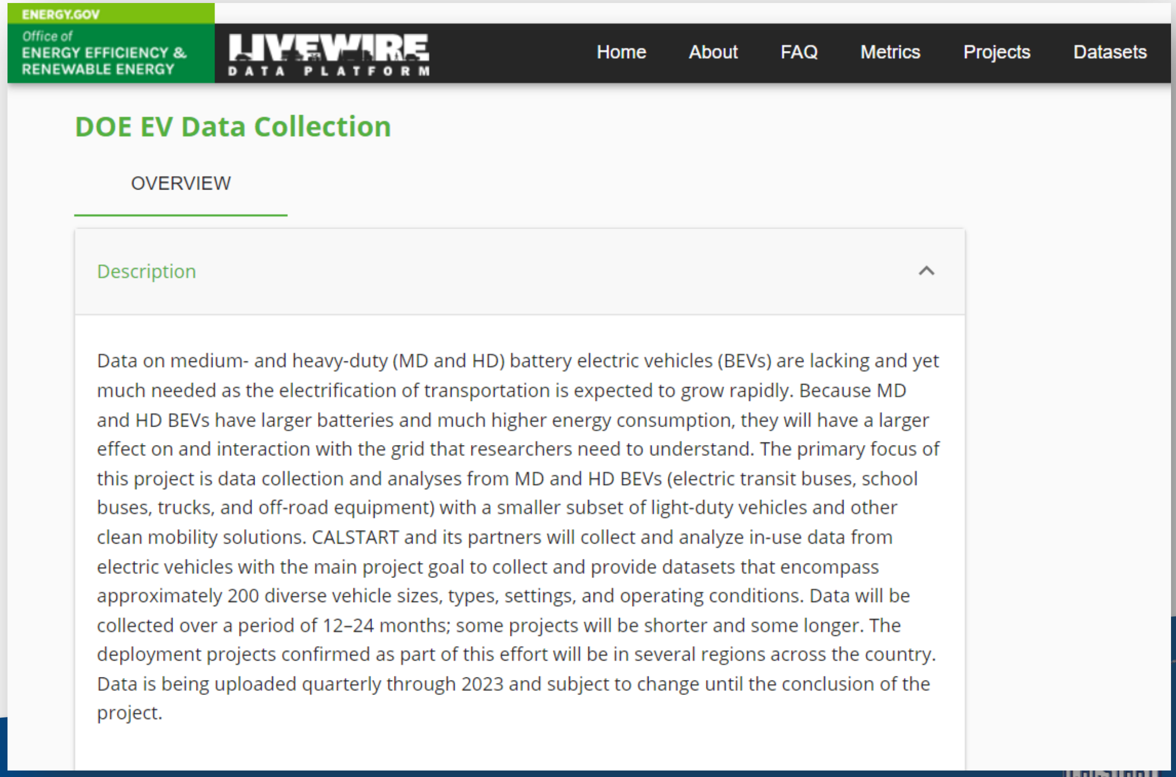
Access the project dashboard

https://calstart.org/projects/medium-heavy-duty-ev-deployment-data/



Download data from Livewire

https://livewire.energy.gov/project/calstart



KEY TAKEAWAYS FROM INTERVIEWS WITH FLEETS

MAINTENANCE STAFF

- Maintenance managers confirmed that EVs usually demand less time to repair and maintain than ICE vehicles, but time spent seeking OEM support and parts can erase that benefit
- Vehicle powertrains are generally reliable, but software issues only fixable by dealership technicians can lead to extended downtime
- Most maintenance staff received some degree of training from OEMs—but some experienced opacity in training how to access software and vehicle diagnostics
- When parts are needed, long lead times often turn what would be short downtime periods into longer ones—but foresee that this issue will lessen with wider adoption
- Higher spare ratio employed theoretically for EVs—most fleets use ICE vehicles to fill in gaps when EVs are down

KEY TAKEAWAYS FROM INTERVIEWS WITH FLEETS CONT.

MANAGEMENT STAFF

- General satisfaction from fleet management about managing EVs in mixed fleets despite growing pains with new technology and support infrastructure
- EVs have been up to most tasks and routes asked of them—a few fleets had their EVs returned to OEMs to have larger motors installed to tackle hillier terrain
- Fleet managers quickly become adept about working around decreased range due to climate extremes (cold winters and hot summers)
- Higher-range vehicles desired, but most fleets are able to work with what's available now
- Demand charges and higher insurance costs vs. ICE vehicles present potential increased costs

DRIVERS

- Uniformly positive response to driving EVs from drivers for a number of reasons, including smooth ride, A/C, etc.
- Drivers usually received some training from OEMs about route management, and play an active role in optimizing the routes EVs take to work around range
- Most drivers start their routes with full batteries and only use depot charging

Q&A

To access the Data Dashboard
please scan above

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