Application of Automated License Plate Readers (ALPR) for Fleet Characterization and Emissions Inventory

Presenter: Sara D. Forestieri

Andre Tok, Stephen Ritchie, Koti Reddy Allu, Alondra Moreno, Sherrie Sala-Moore, Stephanie Kong, Cody Howard, Hang Liu, Jenny Melgo, Abhishek Dhiman, Charanya Varadarajan, David C. Quiros

March 28, 2023

Outline

I. Background: What can we learn from automated license plate reader (ALPR) data?

II. Project 1: Application of ALPR in the Portside Environmental Justice Neighborhoods

III. Project 2: Deployment of ALPRs along major truck corridors in Southern California

Outline

I. **Background: What can we learn from automated license plate reader (ALPR) data?**

II. Project 1: Application of ALPR in the Portside Environmental Justice Neighborhoods

III. Project 2: Deployment of ALPRs along major truck corridors in Southern California

Background on Automated License Plate Reader (ALPR) Systems*

CARB

** ALPR Privacy and Usage Policy (2017)*
https://ww2.arb.ca.gov/sites/default/files/2021-07/arb_alpr_privacy_usage_policy_050317.pdf

Vehicle Characteristics Derived from ALPR Data

ALPR Software Outputs:

- ✓ Plate State/Country
- ✓ Plate Number

Registration Databases (e.g., Department of Motor Vehicles)

Vehicle Characteristics:

- ✓ Gross Vehicle Weight Rating
- ✓ Model Year
- ✓ Fuel type

CARB

How Can ALPR Improve Inventory Assumptions?

EMFAC2021 Fleet Characteristics Based on Registration Data

Current Data Sources	Strengths	Limitations
• **California Department of Motor Vehicles (DMV):** California-registered vehicles • **International Registration Plan (IRP):** Fleet-level info for out-of-state vehicles traveling in the state	• Comprehensive; includes every currently-registered vehicle	• Uncertainty about which out-of-state vehicles in IRP are operating in California • Limited information about where heavy-duty vehicles travel

ALPR data can corroborate and improve EMFAC assumptions

CARB

Potential Emissions Inventory Applications for EMFAC202Y and Beyond

- Improve characterization of heavy-duty trucks operating in California, especially out-of-state registered trucks that travel in the state
- Assess Truck and Bus Regulation compliance rates
- New technology penetration by region (e.g., battery electric trucks)
- Community-scale emissions inventory validation and improvement
- Inform high-resolution inventory development, i.e., greater detail on emissions and activity at higher spatial resolutions

Outline

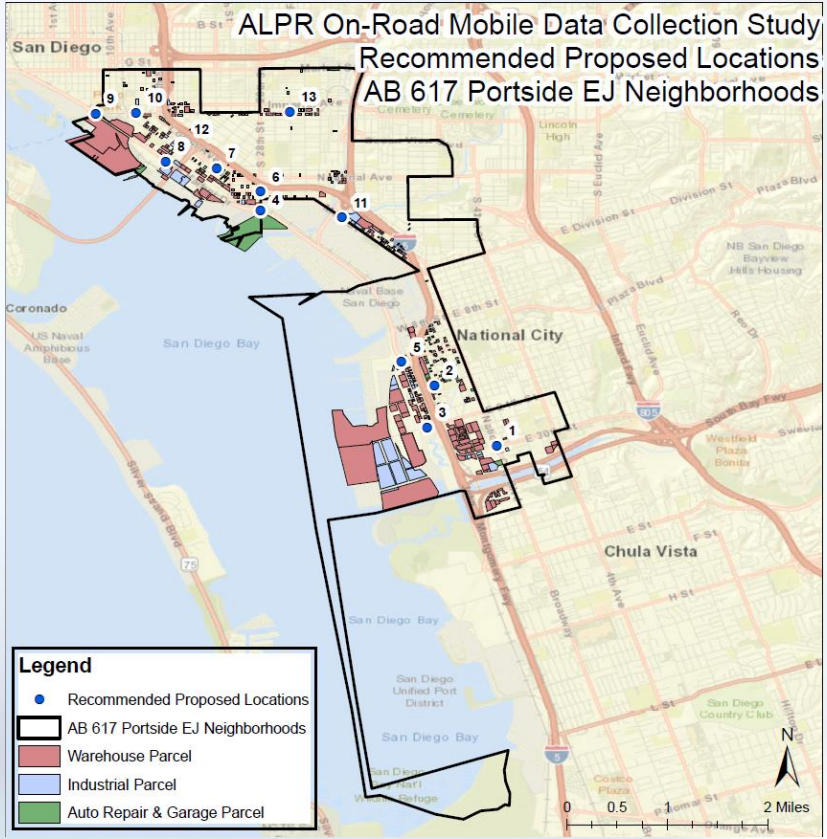
I. Background: What can we learn from automated license plate reader (ALPR) data?

II. Project 1: Application of ALPR in the Portside Environmental Justice Neighborhoods

III. Project 2: Deployment of ALPRs along major truck corridors in Southern California

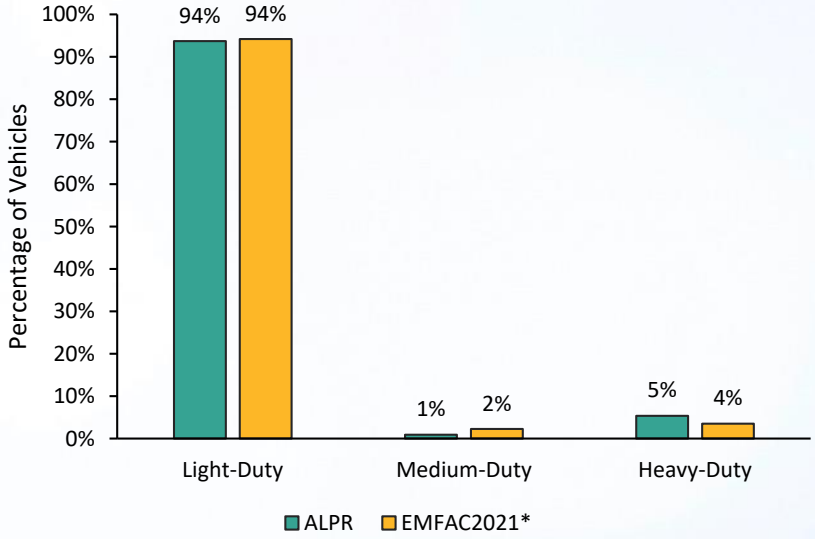
Data Collection Project in the Portside Environmental Justice Neighborhoods

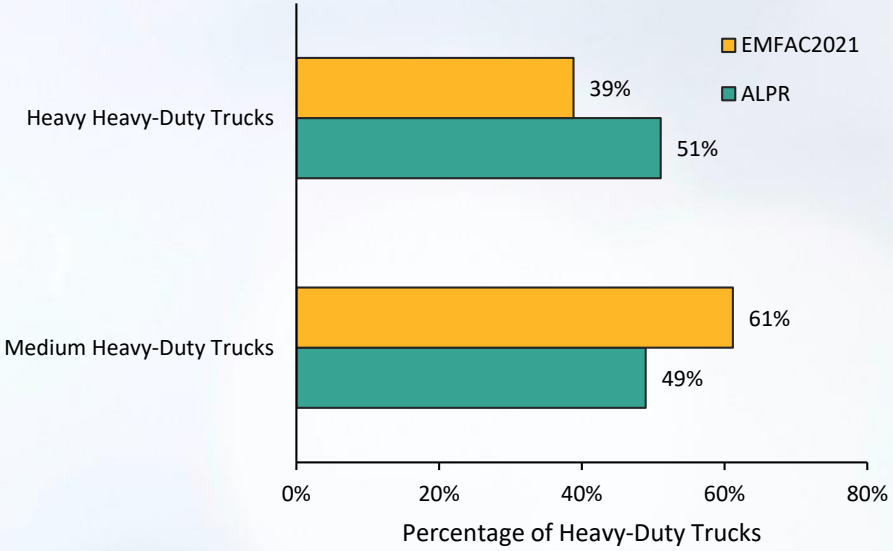
- Collaboration with San Diego Air Pollution Control District
- Collected data with temporary ALPR systems in Summer 2019
- Only processed CA-registered vehicles
- **Goal:** corroborate current emissions inventory assumptions, i.e., fleet mixes and model year distributions from EMFAC San Diego County (registration data)



CARB

Results (Unique Vehicles): Fleet Mix





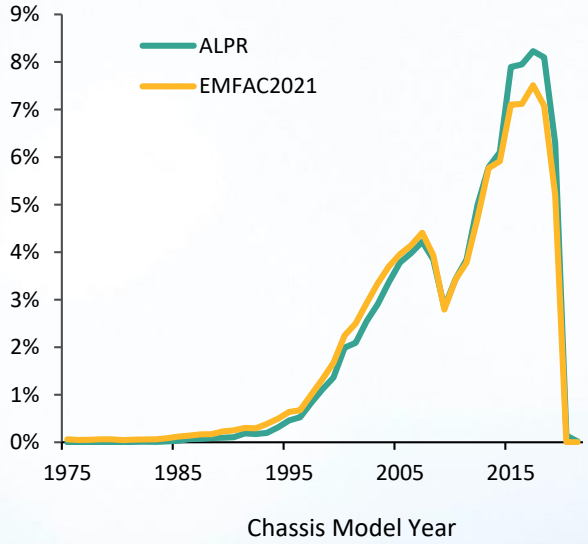
- ALPR-derived light-, medium-, and heavy-duty breakdown compares well to EMFAC2021
- ALPR results suggest a larger contribution of heavy heavy-duty trucks (Class 8 or gross vehicle weight rating > 33,000 lbs) to the overall heavy-duty truck population

CARB

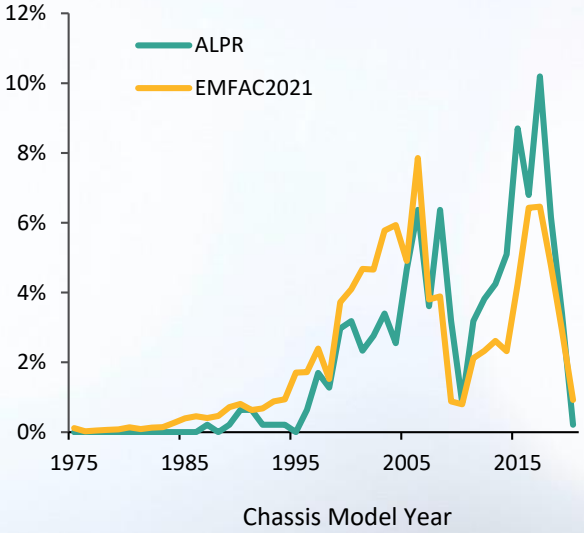
**EMFAC2021 results for San Diego County in CY2019*
EMFAC populations based on California DMV data

Results (Unique Vehicles): Model Year Distribution

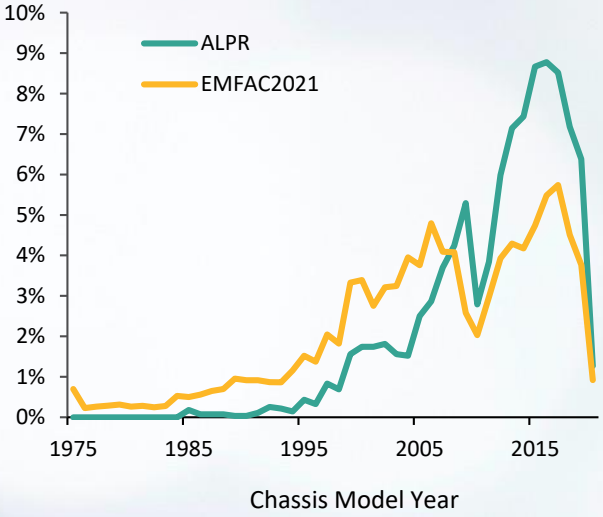
Light-Duty
N = 47,799



Medium-Duty
N = 469



Heavy-Duty
N = 2,752

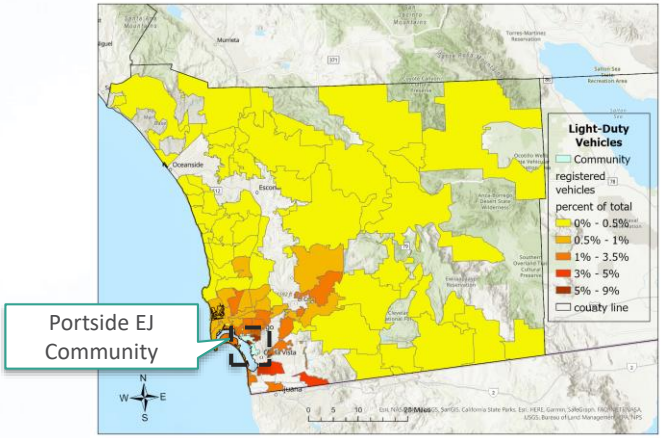


ALPR-derived medium- and heavy-duty vehicles are newer than predicted by EMFAC2021

CARB

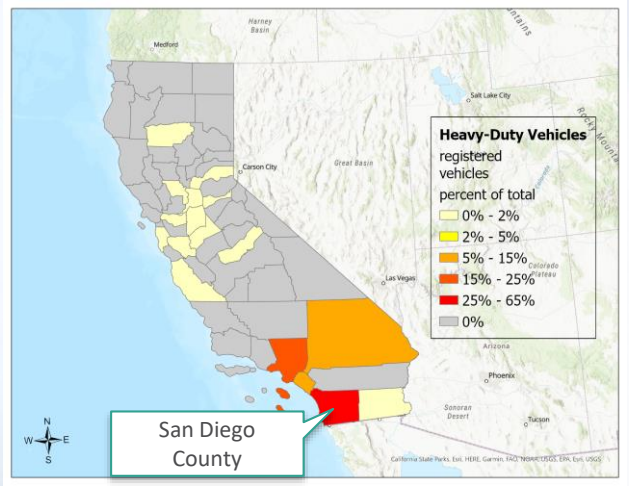
Where Are Vehicles Operating in the Community Registered?

Light-Duty Vehicle Population Fractions by DMV Zip Code



- **30%** of light-duty vehicles are registered within the community
- **83%** are registered within San Diego County
- Significant portion of intra-county travel, especially within a 25 miles of the community

Heavy-Duty Vehicle Population by DMV County



- **22%** of heavy-duty vehicles operating in the community are registered in the community
- **57%** are registered within San Diego County, but a significant portion are registered in other areas, particularly in LA and San Bernardino

CARB

Project 1: Conclusion and Next Steps for Community ALPR Data Collection

- Overall, community fleet mix and model year distributions are consistent with EMFAC2021 county level data
  - Larger heavy heavy-duty fraction – emissions ↑
  - Newer fleet – emissions ↓
  - **Overall effect:** diesel PM - **lower**, NOx – **neutral**
- Significant fraction of travel from vehicles registered outside of the community.
- Analyze ALPR data from other CARB projects in other AB617 communities.
- Improve future EMFAC versions to better capture local-scale activity and emissions.

Outline

I. Background: What can we learn from automated license plate reader (ALPR) data?

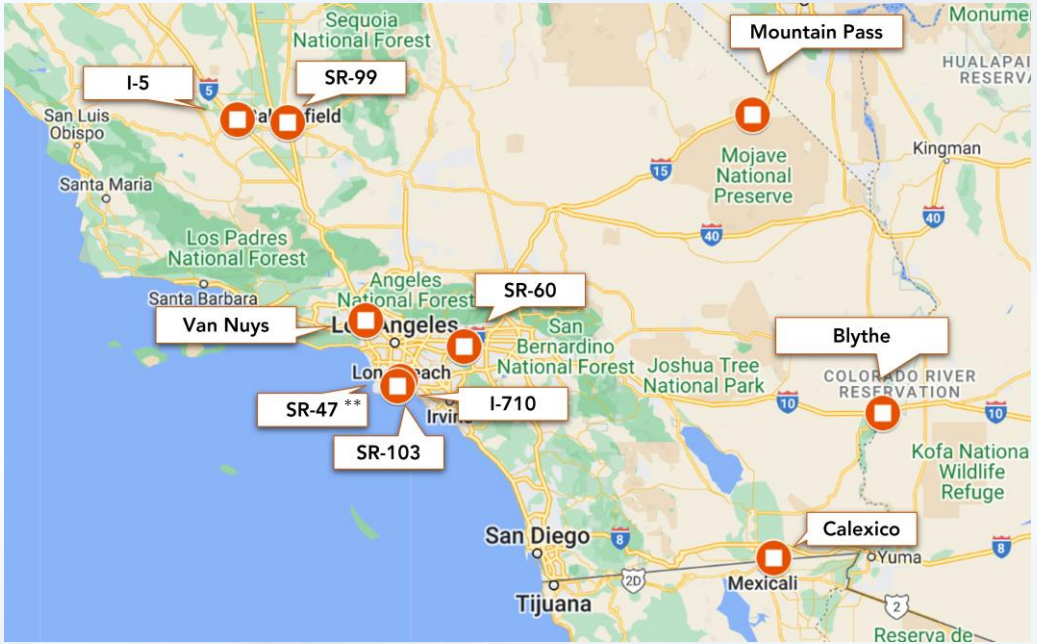
II. Project 1: Application of ALPR in the Portside Environmental Justice Neighborhoods

III. Project 2: Deployment of ALPRs along major truck corridors in Southern California

CARB

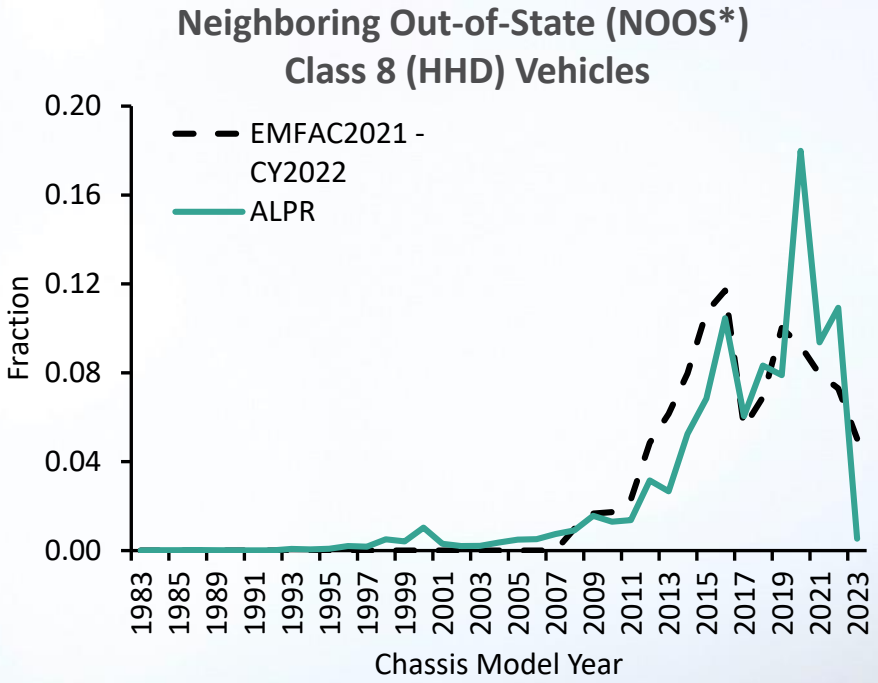
CARB's ALPR Contract with UC Irvine

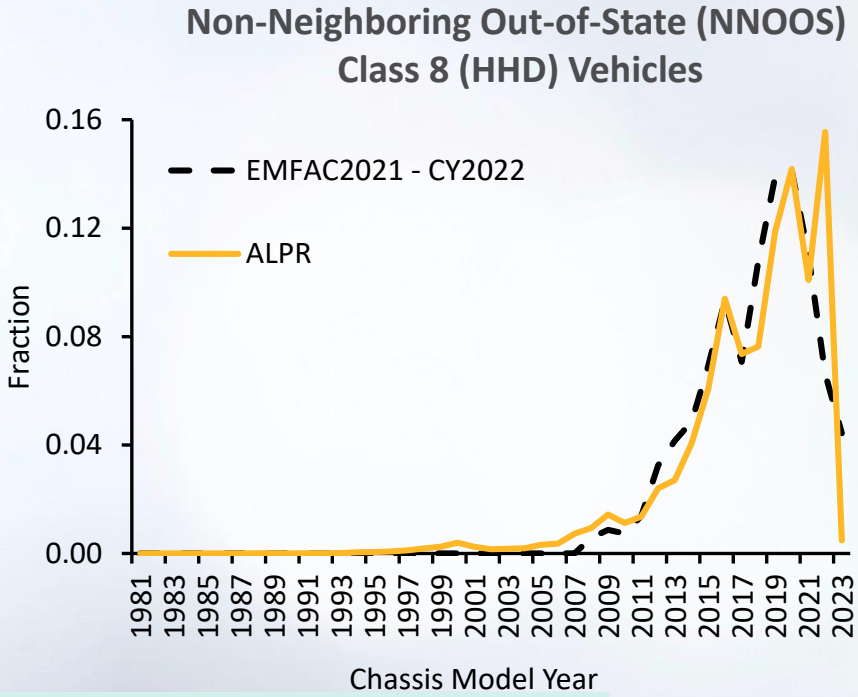
- A contract with UC Irvine (UCI), started in June 2020, to install Automated License Plate Readers
- **Goal:** improve EMFAC assumptions - *out-of-state* heavy-duty fleet characteristics and Truck and Bus compliance
- 10 permanent systems have been installed
- **Data period analyzed:** Jan – Dec 2022



** SR-47 not yet collecting data due to on-going construction nearby

Heavy-Duty (HD) Out of State Vehicle Model Year Distribution in 2022



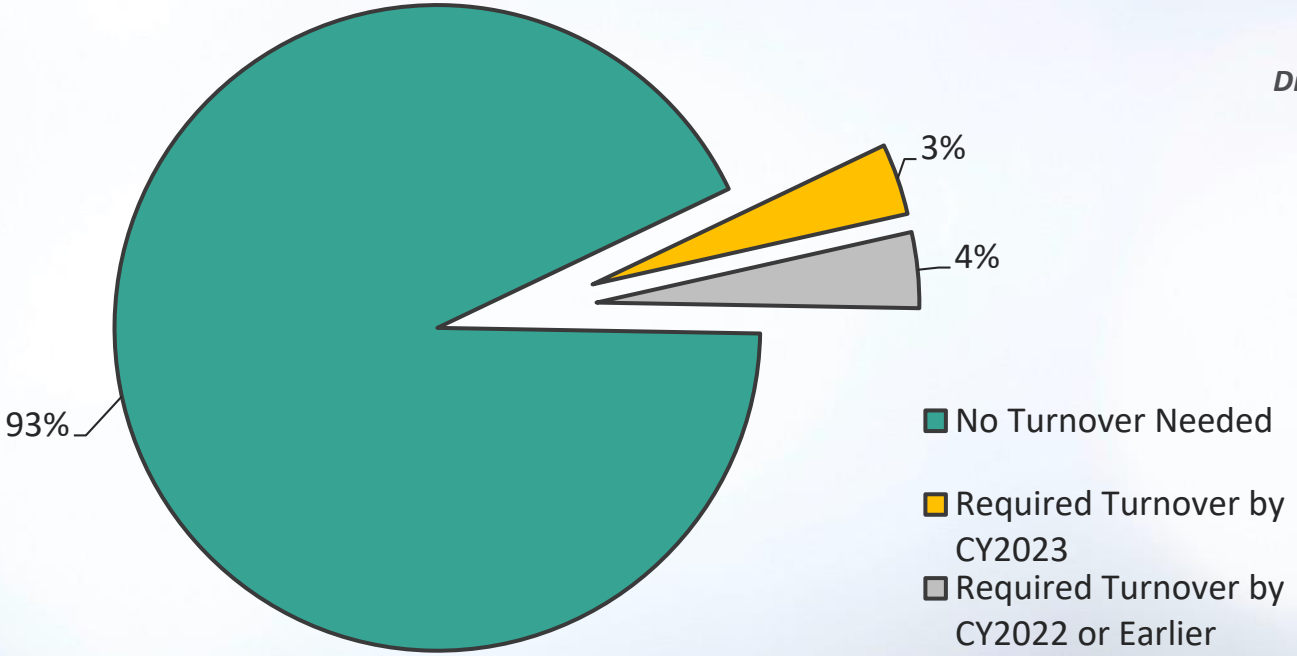


Overall, ALPR predicts a slightly newer fleet than EMFAC2021
→ Less deterioration of the emissions controls systems

CARB

* NOOS = NV, AZ, ID, OR, WA, BC

Truck and Bus Compliance Rates for HD Out-of-State Fleets Detected by ALPR in 2022

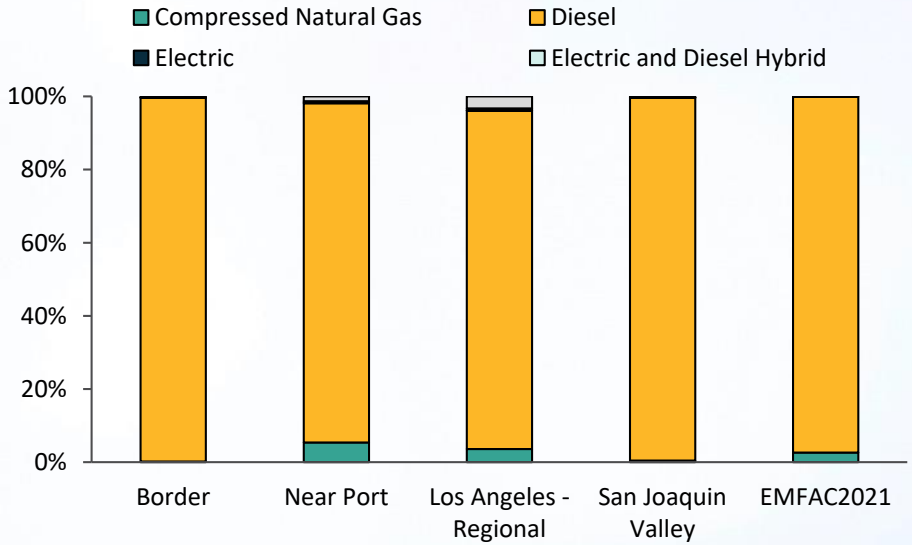


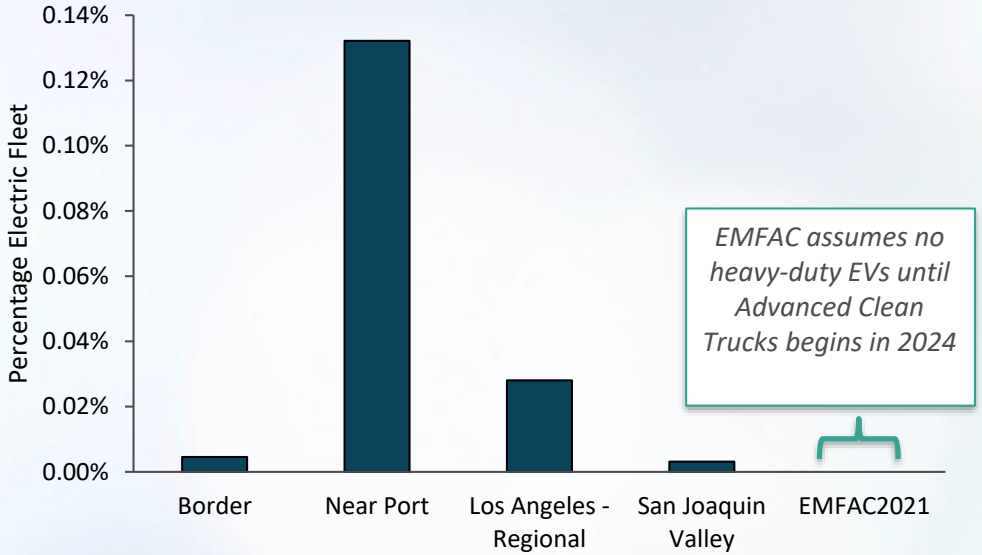
Diesel Vehicles Subject to Truck & Bus Rule were/are required to meet 2010 Engine Requirements by January 1st of these Calendar Years Unless they have an authorized exemption or are not subject to Rule.

CARB

Overall Compliance Rate in 2022: **96%** (considering exemptions)

Regional HD Technology Distribution in 2022





Largest fractions of natural gas vehicles near the port and operating in the Los Angeles Region

Electric vehicles are currently a very small portion of the heavy-duty fleet. Largest fractions operating near the port.

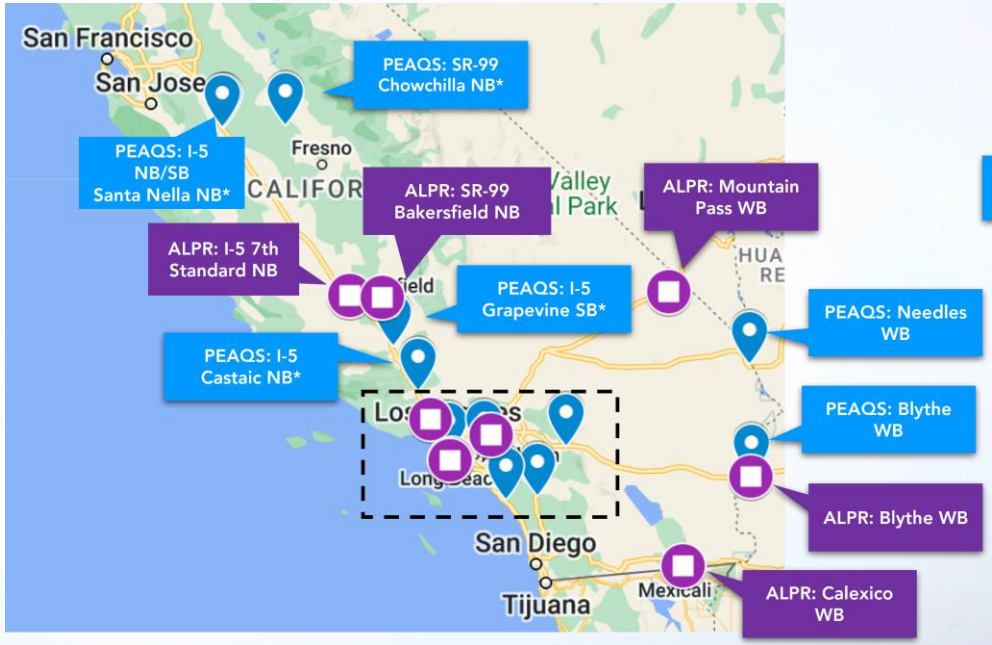
CARB

Border – Mountain Pass, Blythe, Calexico; **Near Port** – I-710, SR-103; **LA Regional** – SR-60, I-405; **San Joaquin Valley** – SR-99, I-5

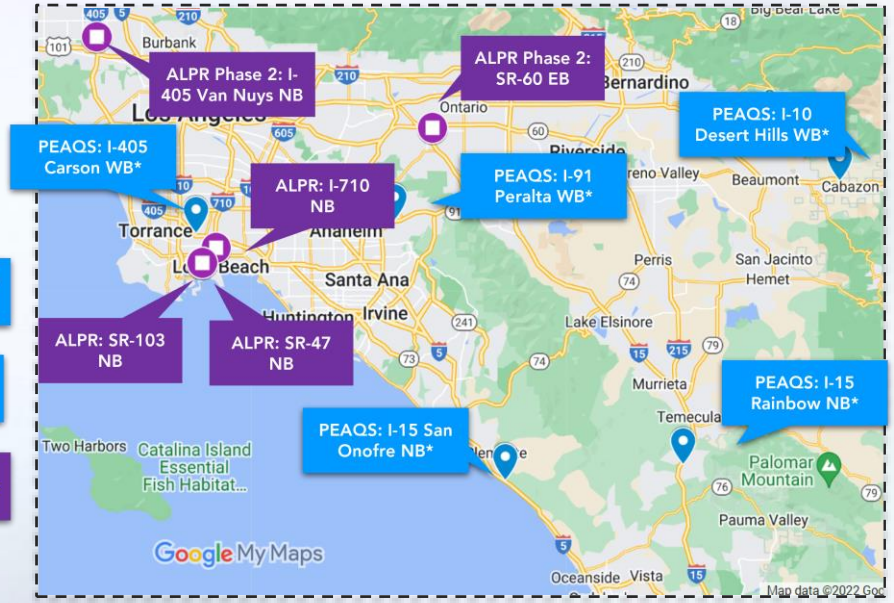
Project 2: ALPR Next Steps

- Amend contract to install ALPRs on highways in 2-3 more locations for two additional years. Utilize ALPR data from other CARB sources, such as Portable Emission Acquisition Systems (PEAQS).
  - Expanded network to characterize regional travel patterns and fleet characteristics. Complement high-resolution Streetlight analysis (previous presentation by Dr. Jiachen Zhang).
- Update EMFAC202Y model year distributions for out-of-state heavy-duty vehicles
- Assess Truck and Bus Regulation compliance rates in 2023
- Continue to track location-dependent roll-out of zero emission vehicles

Statewide



Zoomed In (Closer to Los Angeles)



*** Planned Installations**

Thank you!

Sara Forestieri, Ph.D.

Manager

On-Road Model Development Section (ORMDS)

California Air Resources Board

sara.forestieri@arb.ca.gov

We use a variety of different data sources

Each provide unique opportunities to improve EMFAC

Replica — An initiative of Sidewalk Labs

STREETLIGHT Big Data for Mobility

Data loggers

Real world emissions measurement

Surveys

CAMBRIDGE SYSTEMATICS

Emergence of big data like StreetLight or Google Replica

Telematics

Cell Phone/GPS

Sensors/on-board diagnostic data

Automated License Plate Readers

STATE OF CALIFORNIA DMV DRIVING CHANGE... DEPARTMENT OF MOTOR VEHICLES

Registration Data

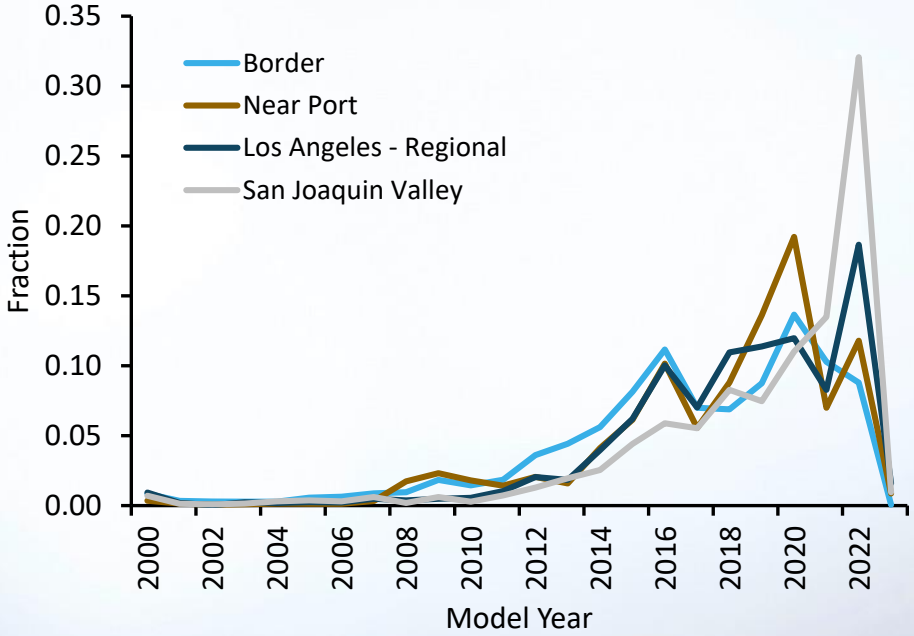
Resolution/Cost

Sample Size/Representativeness

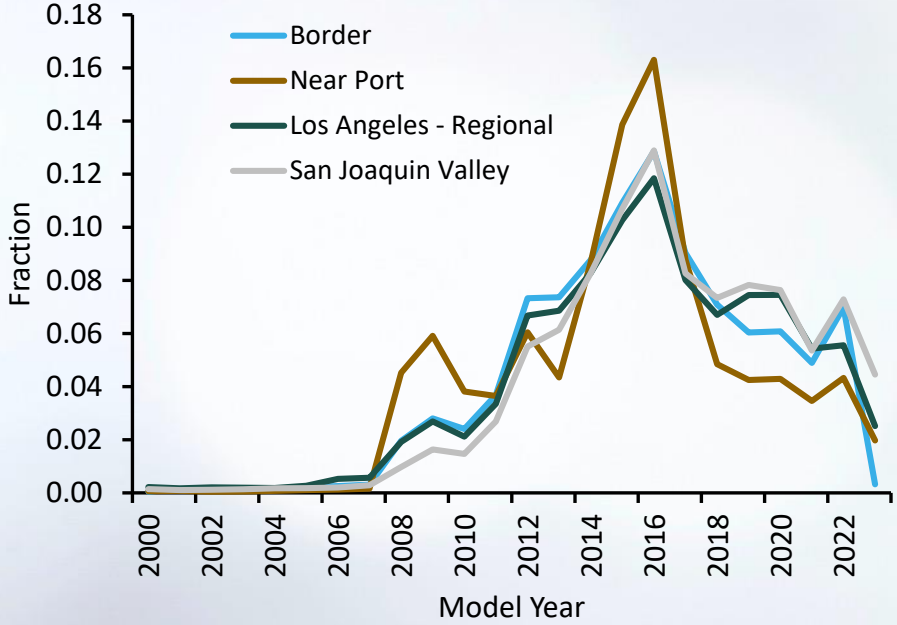
CARB

Heavy-Duty Vehicles: Regional Model Year Distributions in 2022

Out-of-State Registered Vehicles

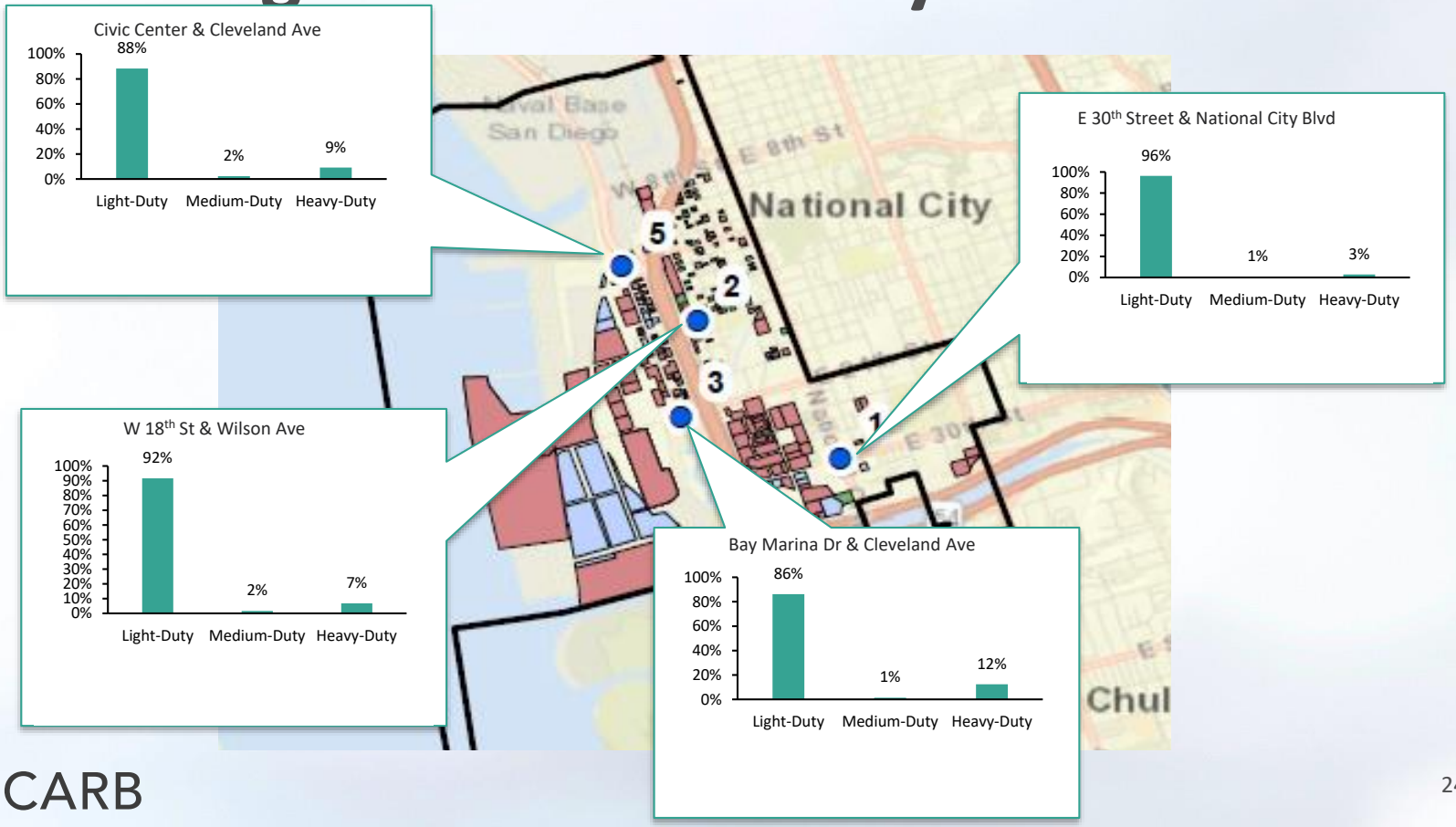


California Registered Vehicles

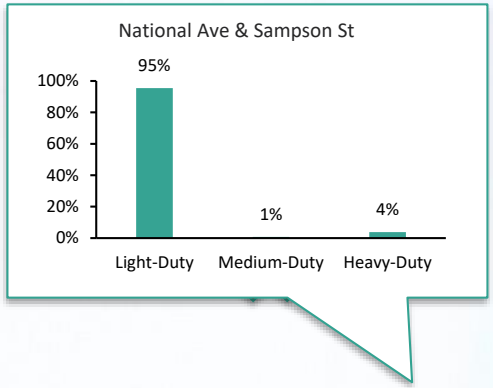


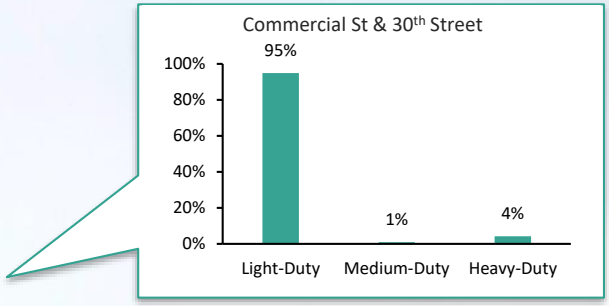
CARB

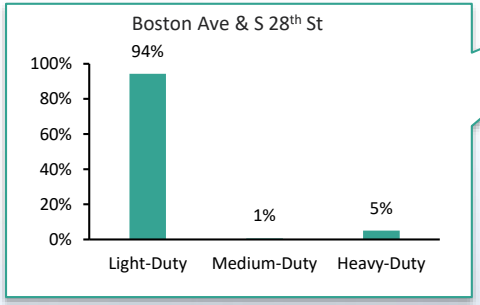
Weight Distribution by Location

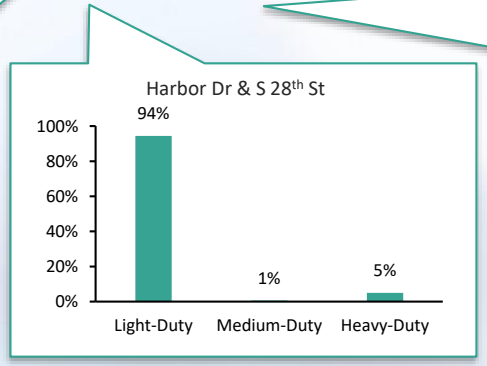


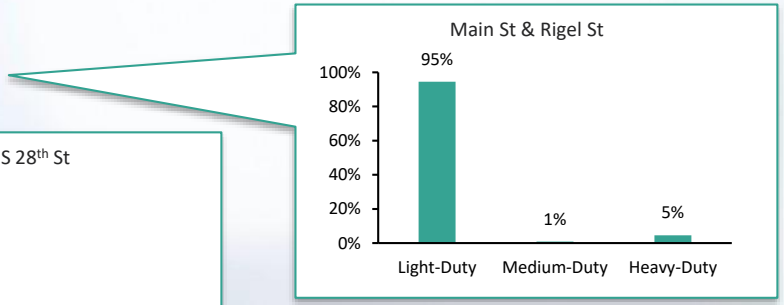
Weight Distribution by Location





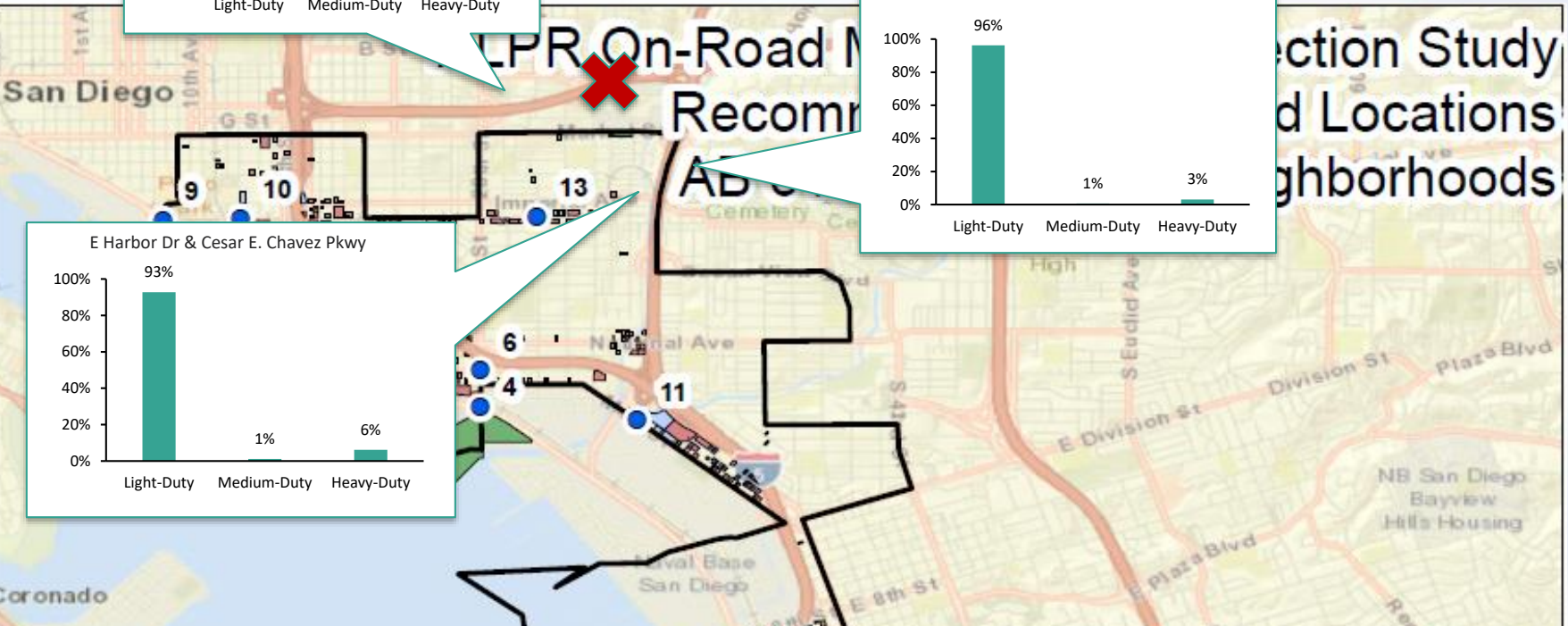


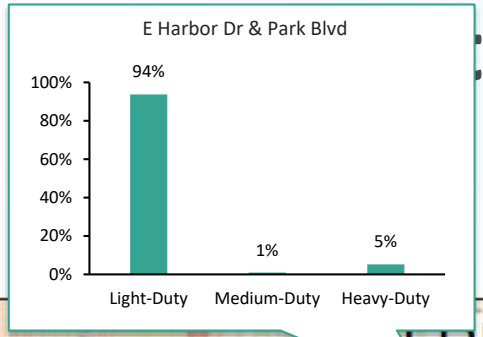


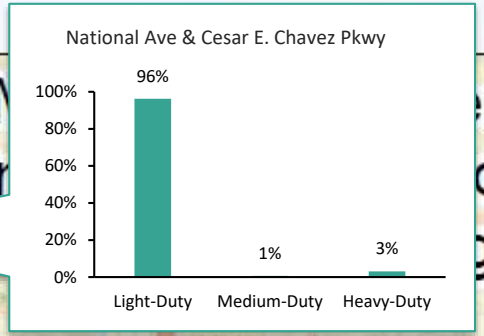


CARB

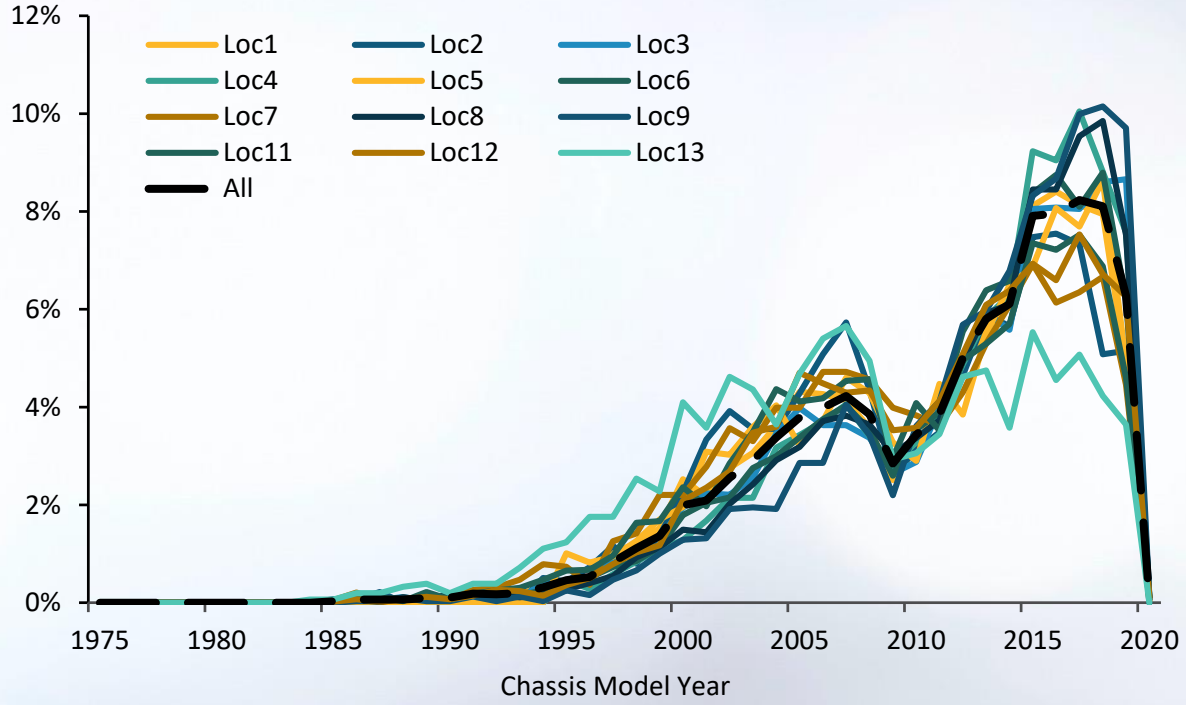
Distribution by Location





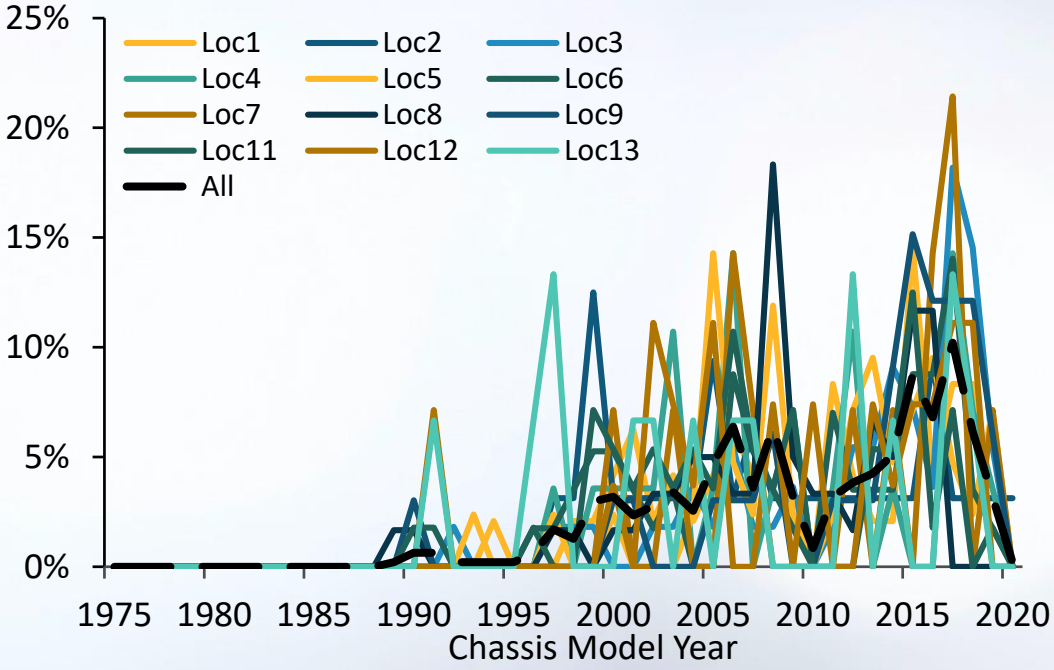


Model Year Distributions Between Locations: Light-Duty



CARB

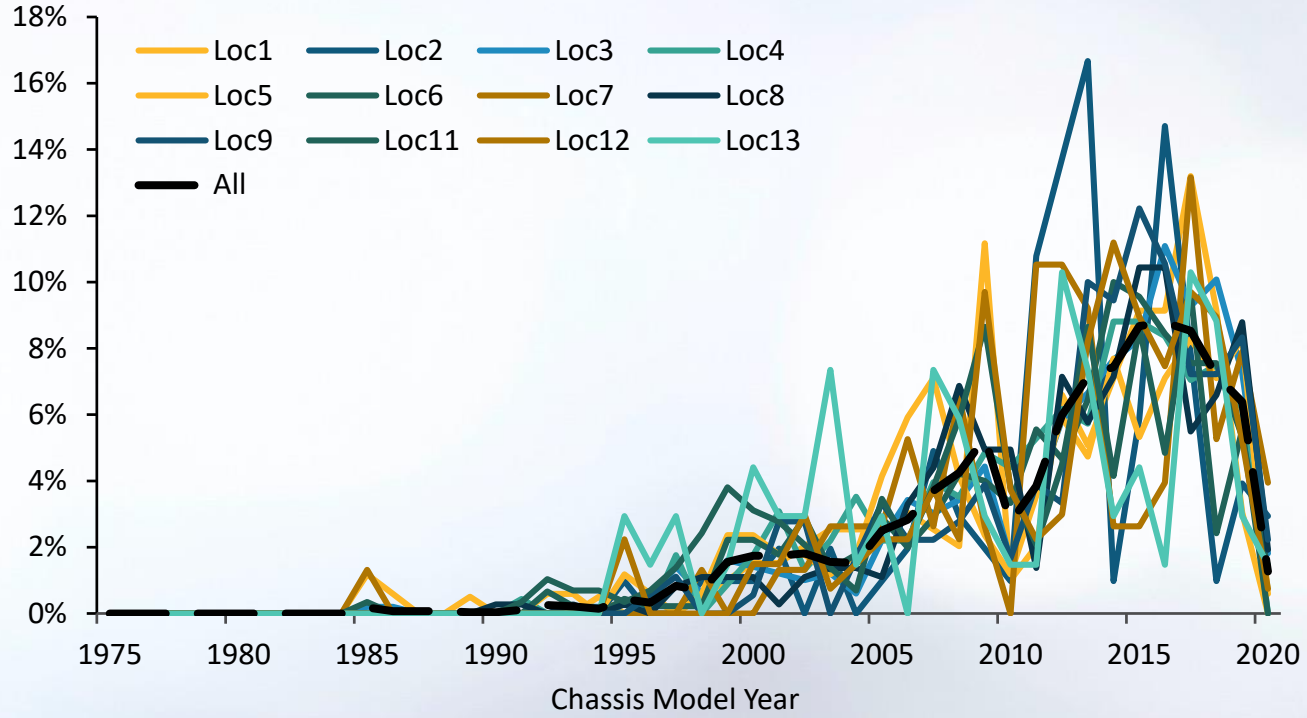
Model Year Distributions Between Locations: Medium-Duty



The sample size for Medium-Duty vehicles is too small to tease out differences between locations

CARB

Model Year Distributions Between Locations: Heavy-Duty



CARB