



# **Accounting for Zero-Emission Vehicle (ZEV) Adoption in California's On-Road Mobile Source Emissions Inventory (EMFAC)**

Mobile Source Analysis Branch  
California Air Resources Board

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CAPCOA Symposium  
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# Content

- Background of the EMFAC model
- Historical vehicle activity and ZEV population estimates
  - Light-duty vehicles (LDV)
  - Medium and heavy-duty vehicles (MHDV)
- ZEV population forecasting

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# Background of EMFAC

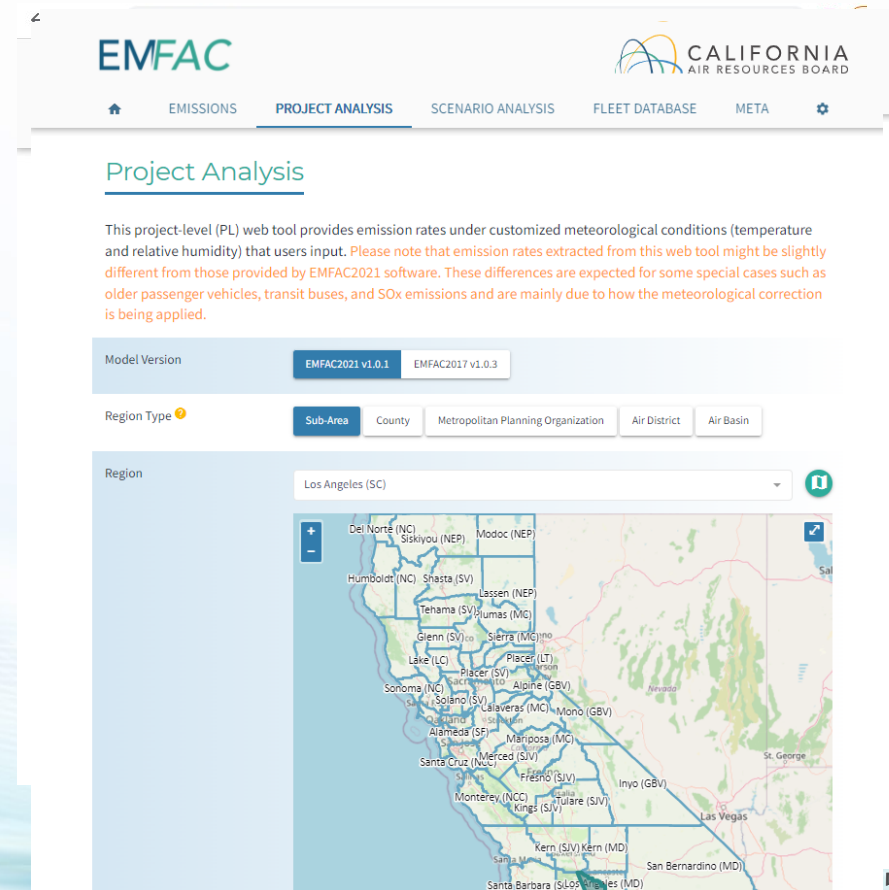
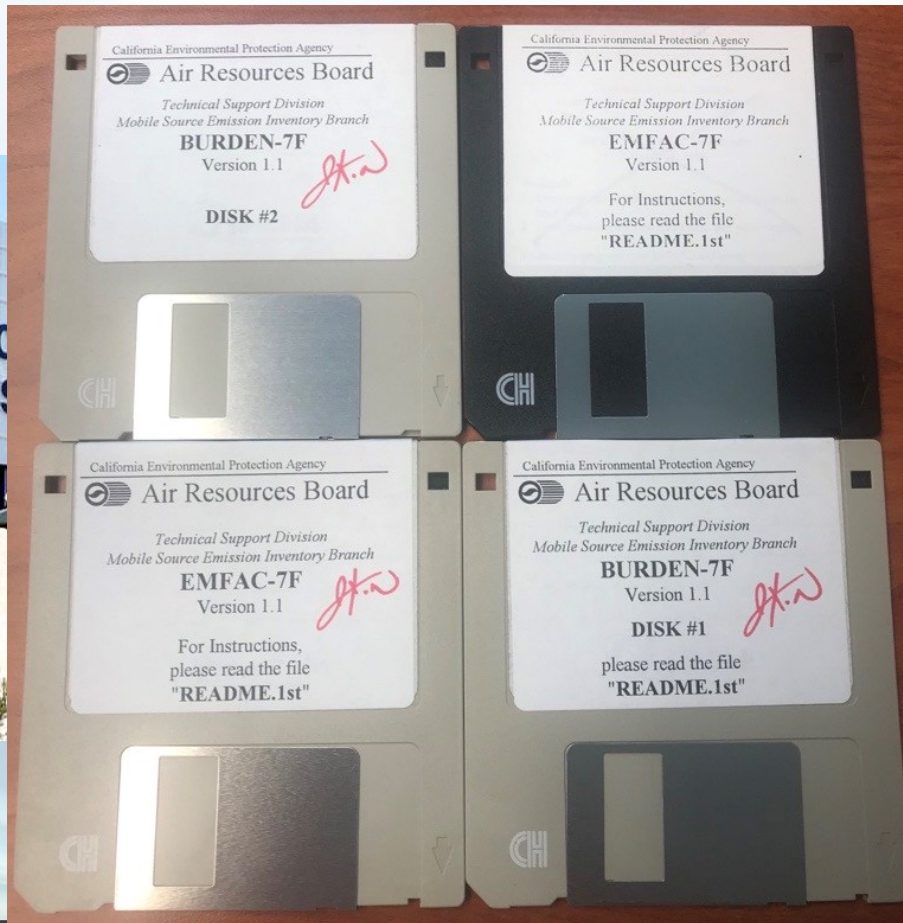




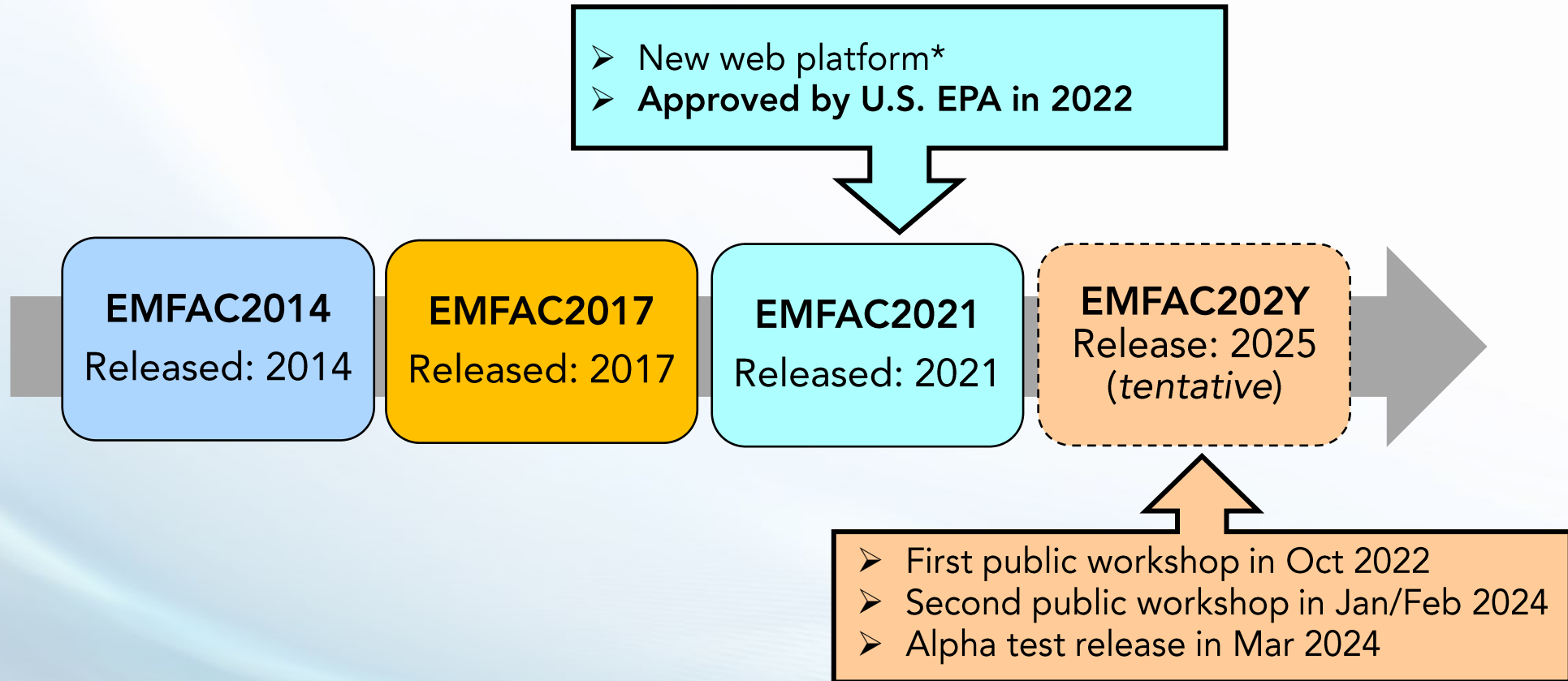
# Decades of EMFAC Evolvement

*from humble beginnings...*

<https://arb.ca.gov/emfac/>



# EMFAC is Updated Every 3-4 Years



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# Major Data Sources for Historical LDV Population in EMFAC

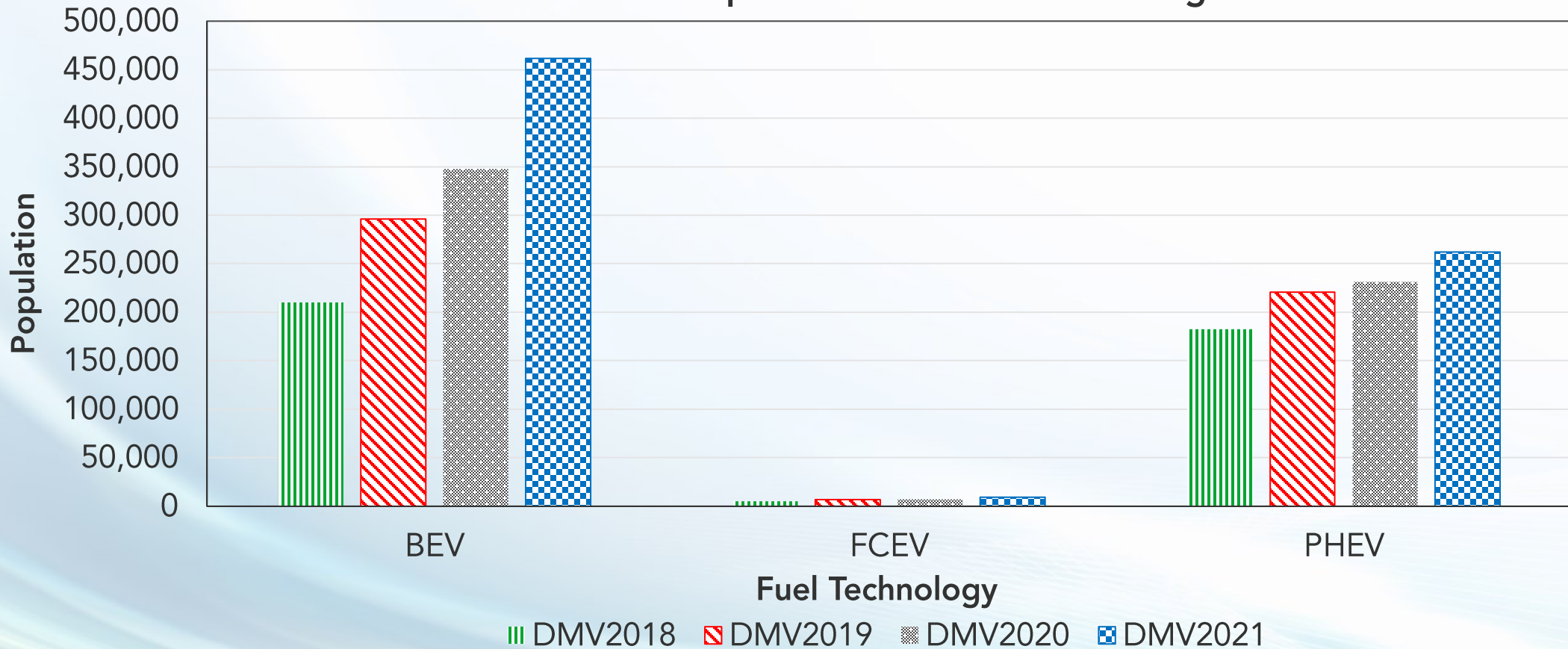
- California Department of Motor Vehicles (DMV) provides annual vehicle registration data including VIN, fuel type, make, and model year
- VINtelligence Web Service fills in missing data fields for vehicle characteristics
- VIN stems to identify light-duty ZEVs, including plug-in hybrid electric vehicles (PHEV), battery electric vehicles (BEV), and fuel cell electric vehicles (FCEV)





# Statewide Light-Duty ZEVs (Below 8,500 lbs)

Zero Emissions Vehicle Population in DMV2018 through DMV2021



# Major Data Sources for Historical HDV Population in EMFAC

- California-registered vehicles: DMV Vehicle Registration Database

- Non-California-registered vehicle characterization:

- International Registration Plan (IRP) Clearinghouse Data
- International Fuel Tax Agreement (IFTA) Data



- Identification of certain vocations:

- Data from ports to identify drayage trucks
- National Transit Dataset/Innovative Clean Transit Reporting Data for buses
- ...



# Medium-Duty and Heavy-Duty ZEVs (Above 8,500 lbs)

- Because there were few zero-emission trucks registered in 2019, they were not included in EMFAC2021 for historical calendar years (2000-2019)
- We plan to include historical zero-emission trucks (based on DMV data from 2020-2022) in EMFAC202Y
- We will use reporting data for Advanced Clean Trucks (ACT) and Advanced Clean Fleets (ACF) regulations
- ZEV population of buses were estimated based on the National Transit Bus data in EMFAC2021 and will be updated with the reporting data for Innovative Clean Transit (ICT) in EMFAC202Y

# EMFAC Estimates Where Vehicles Travel

- EMFAC adjusts vehicle population to represent where vehicles travel in geographical area indexes (GAIs); EMFAC population by GAI is different from registration data
- We are exploring the applications of big data (provided by Streetlight, Geotab, and Replica) to refine population/VMT spatial allocations

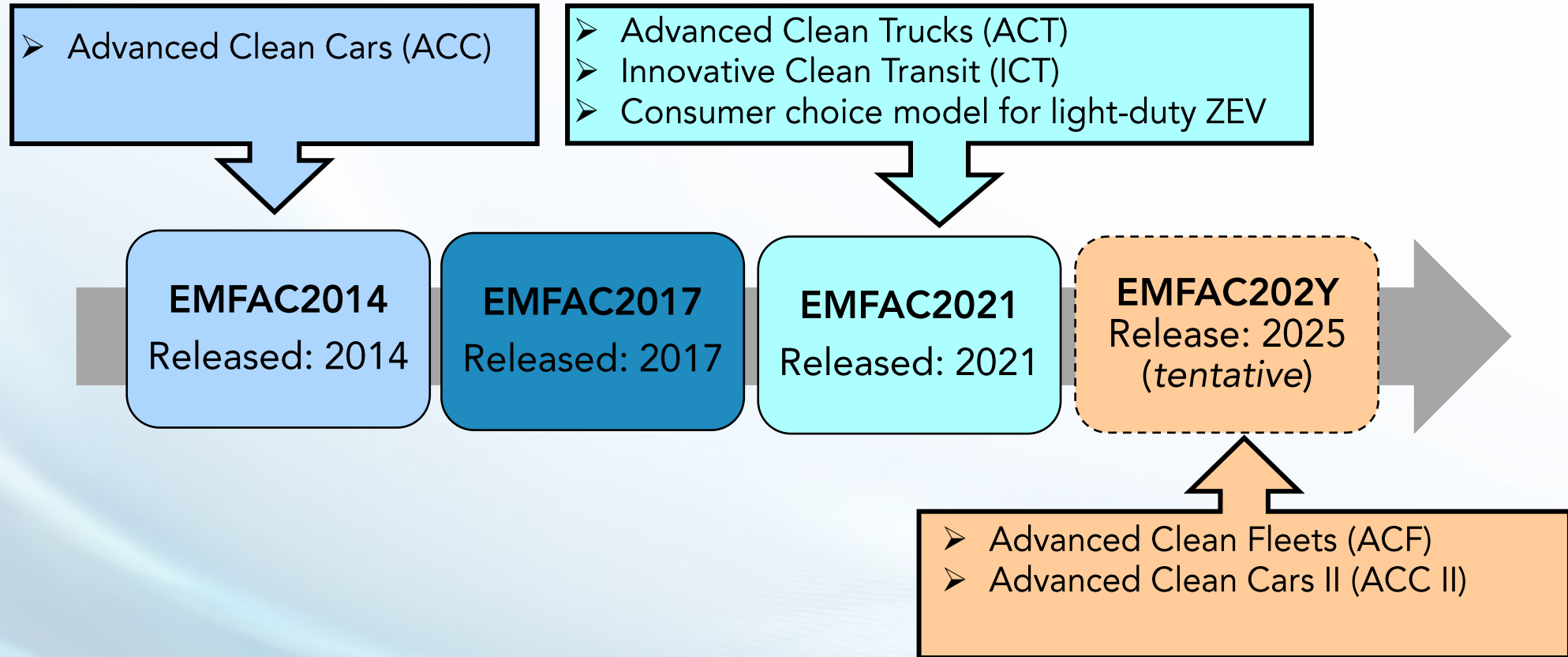
Variables	EMFAC2021	New Data Sources
<b>Heavy heavy-duty VMT and population spatial allocation</b>	Vehicle survey & California Motor Vehicle Stock, Travel, and Fuel Forecast (MVSTAFF)	StreetLight, Geotab, Replica (Future EMFAC versions)
<b>Light-duty VMT and population spatial allocation</b>	California Vehicle Activity Database (CaVAD) tool developed by UC Irvine	StreetLight, Replica (Future EMFAC versions)

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- **ZEV population forecasting**



# EMFAC ZEV Forecasting Reflects Adoption of ZEV Regulations



# Light-Duty ZEV New Sales Modeling

## Projection

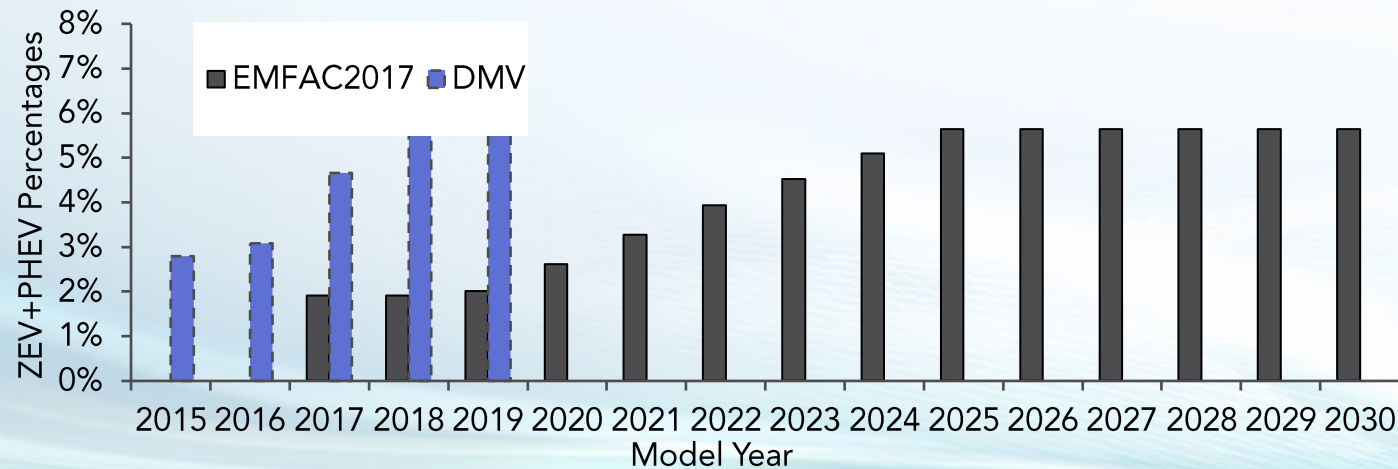
Most Likely (Minimum) Compliance with ZEV Regulation in Advanced Clean Cars

Historical  
DMV data

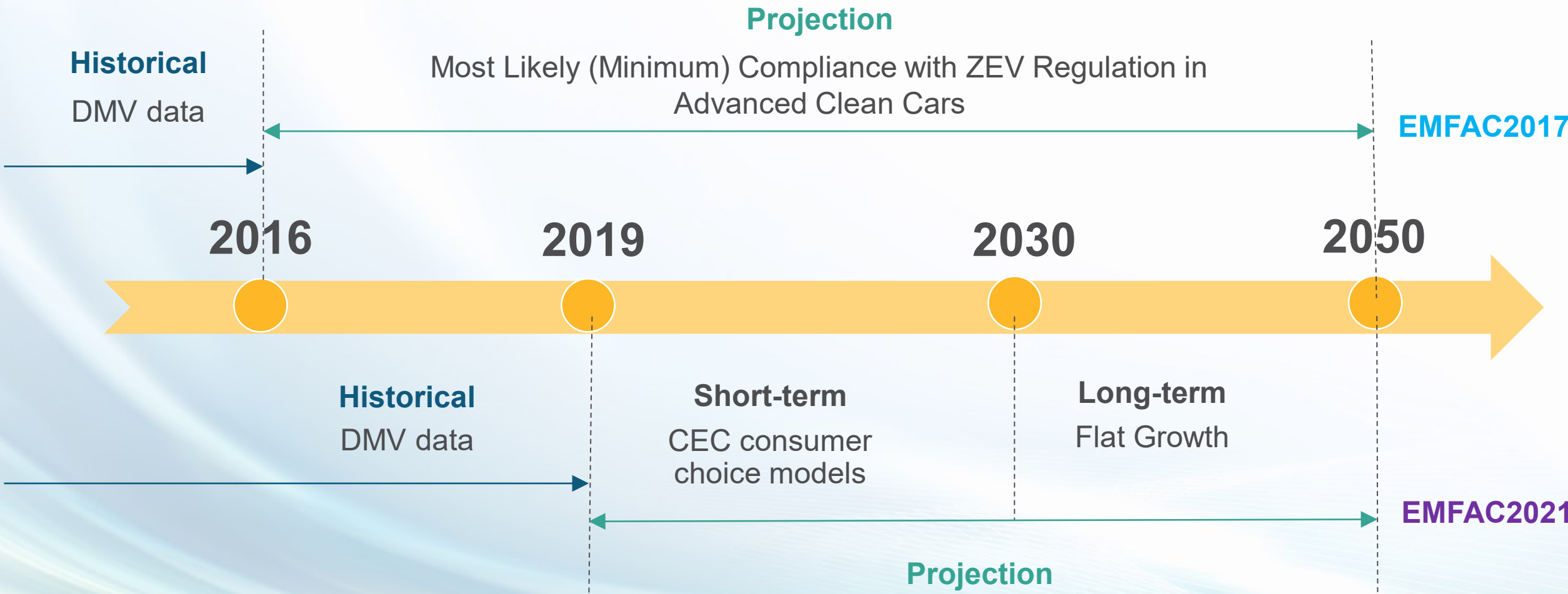
EMFAC2017

2016

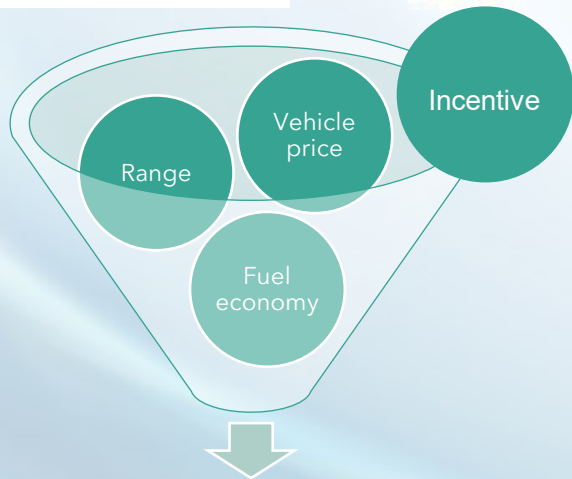
2050



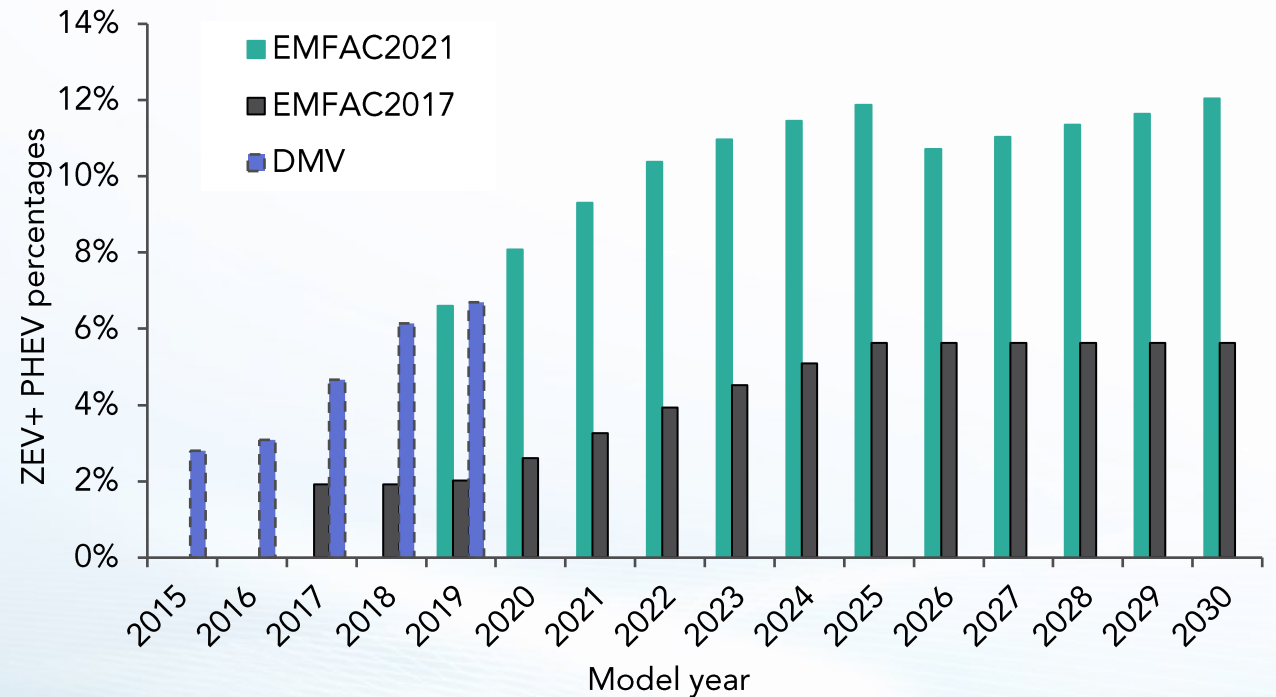
# Light-Duty ZEV New Sales Modeling



# CEC's Consumer Choice Model was Used to Forecast ZEV and PHEV Market Shares in New Sales

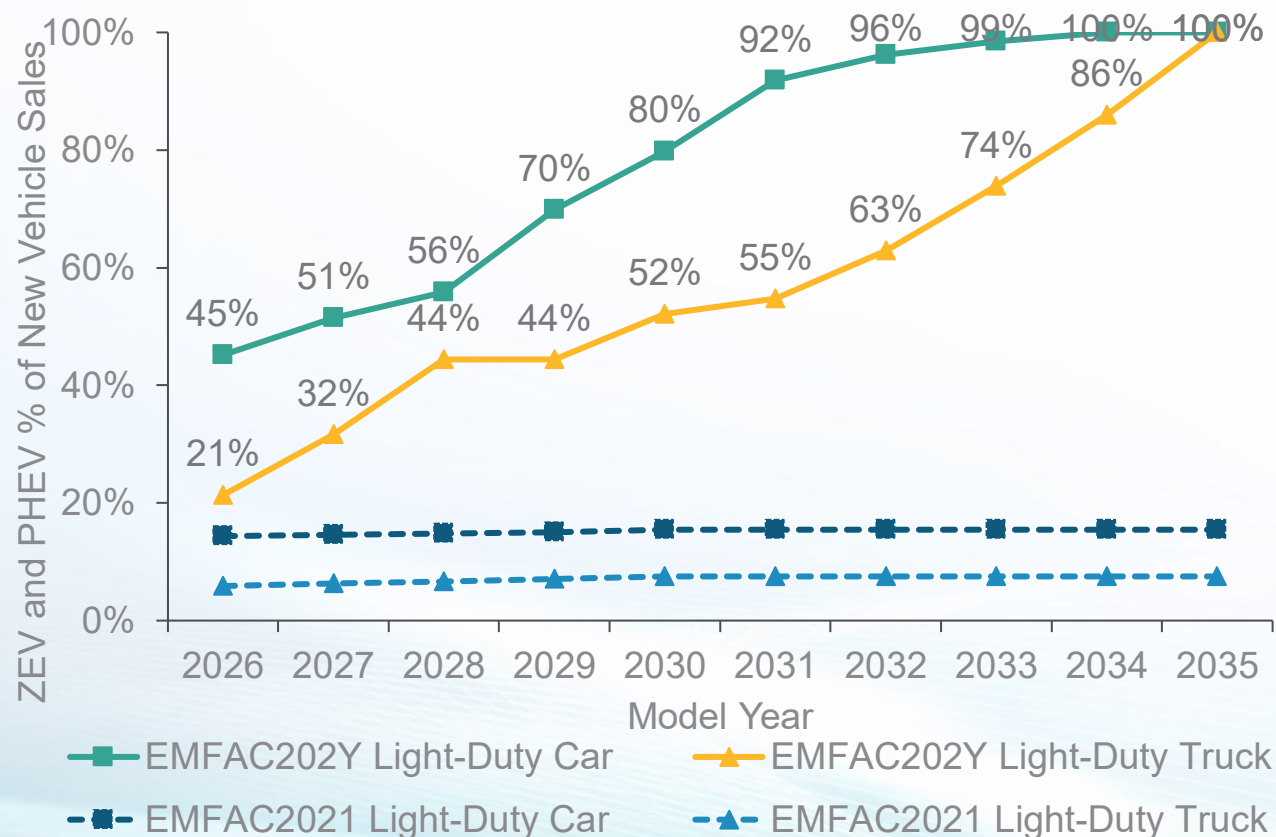


Vehicle population by fuel type and age



# EMFAC202Y will Reflect ACC II Regulation ZEV and PHEV Requirements

- ACC II set ZEV requirements for new 2026+ model year (MY) light-duty vehicles
- Effective date: November 2022
- ACC II most likely compliance scenario will be used for estimating statewide ZEV and PHEV percentages in new Sales
- CARB executed a contract to forecast regional variation in ZEV adoption

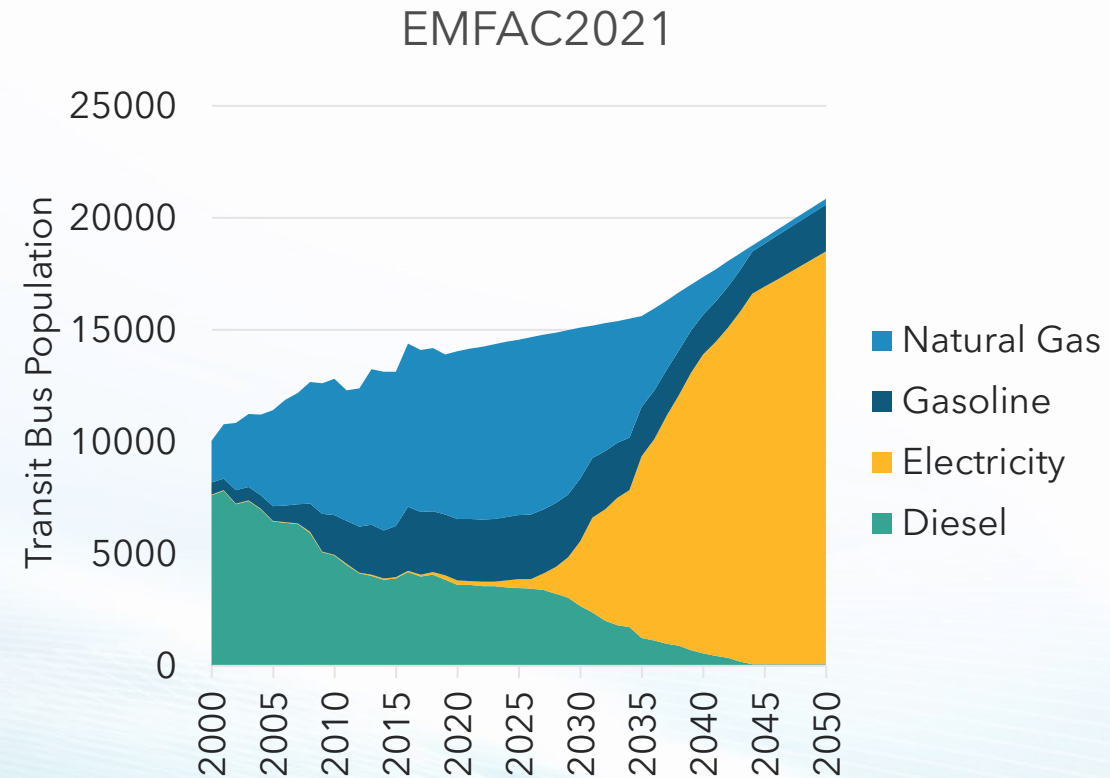




# Innovative Clean Transit (ICT)

- Requires all public transit agencies to gradually transition to 100% zero-emission bus fleets
- Effective date: October 2019

Year	Zero-Emission % of New Bus Purchase	
	Large Agency	Small Agency
2023	25%	-
2024	25%	-
2025	25%	-
2026	50%	25%
2027	50%	25%
2028	50%	25%
2029 and after	100%	100%



# Advanced Clean Trucks (ACT)

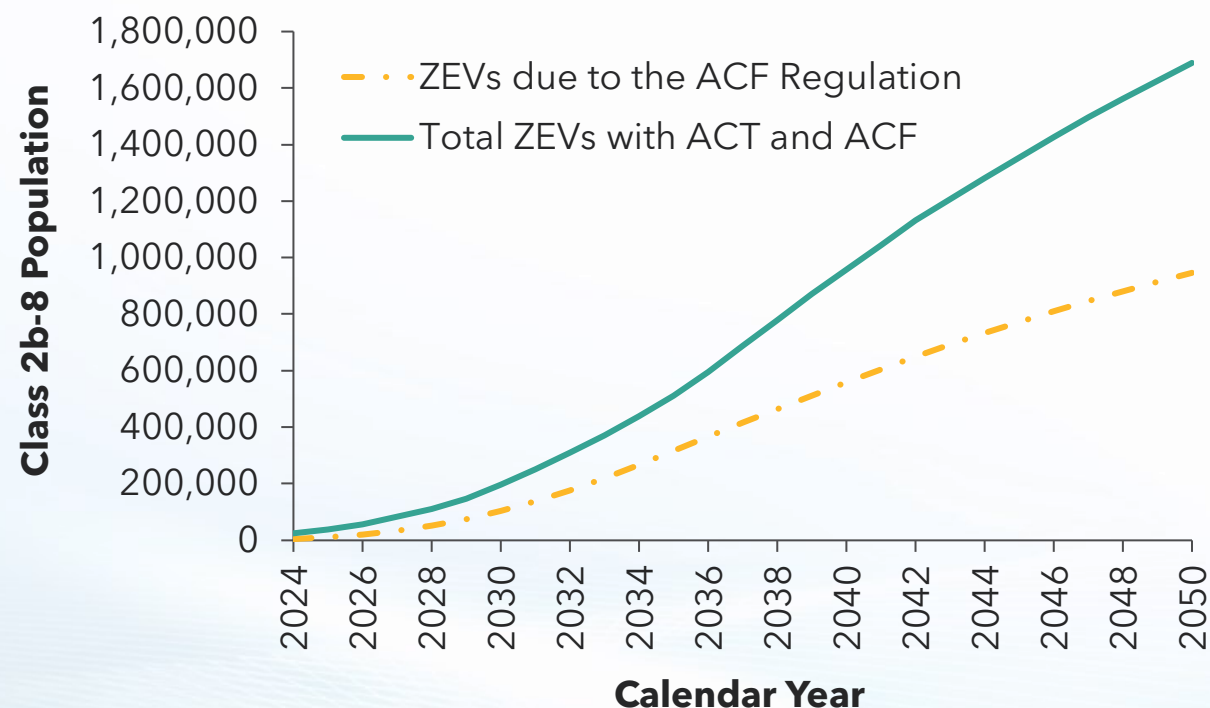
- Requires truck manufacturers with >500 annual California sales to sell an increasing percent of zero-emission trucks and buses from 2024 to 2035
- Effective date: March 2021

Model Year	% of Zero-Emission Trucks in Total New Sales in CA		
	Class 2b-3	Class 4-8 Vocational	Class 7-8 Tractors
2024	5%	9%	5%
2025	7%	11%	7%
2026	10%	13%	10%
2027	15%	20%	15%
2028	20%	30%	20%
2029	25%	40%	25%
2030	30%	50%	30%
2031	35%	55%	35%
2032	40%	60%	40%
2033	45%	65%	40%
2034	50%	70%	40%
2035 and after	55%	75%	40%

# Advanced Clean Fleets (ACF)

- Zero-emission truck requirements for fleets
  - State and Local Government Fleets
  - Drayage Fleets
  - High Priority and Federal Fleets
- Requires 100% ZEV Sales by manufacturers by 2036
- Effective date: October 2023

**Statewide ZEV Population Forecast with ACF\***



\* Population projection based on EMFAC2021 was used during the rulemaking process of ACF

# Summary

- EMFAC estimates historical ZEV population by combining a variety of data sources including the DMV registration data and exploring new datasets to evaluate our estimates
- ZEV population forecasted by EMFAC generally reflects adopted ZEV regulations, while light-duty ZEV in EMFAC2021 was forecasted based on consumer choice models
- For questions about EMFAC, feel free to email [emfac@arb.ca.gov](mailto:emfac@arb.ca.gov)