



# Advanced Clean Fleets Regulation

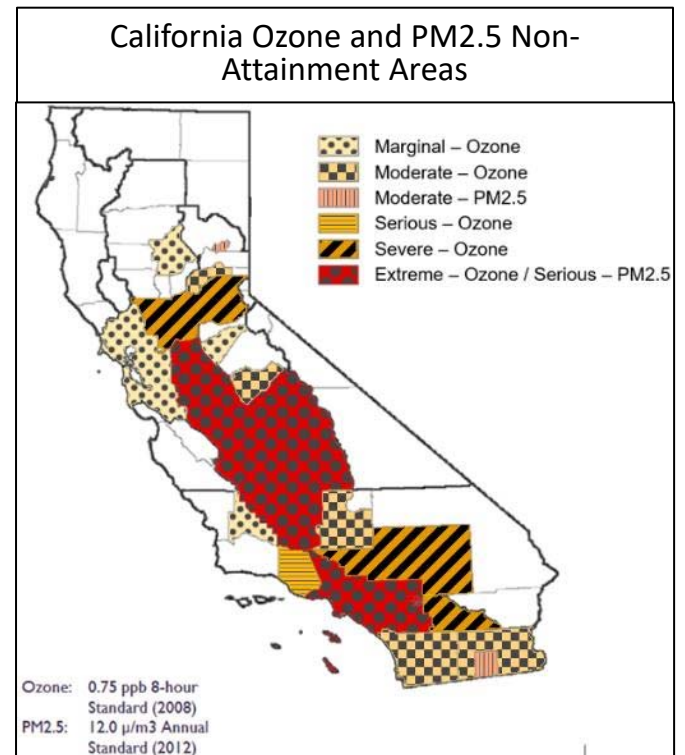
2022 AQMP Mobile Source Working Group

Heavy-Duty Trucks (Meeting #2)

March 24, 2021

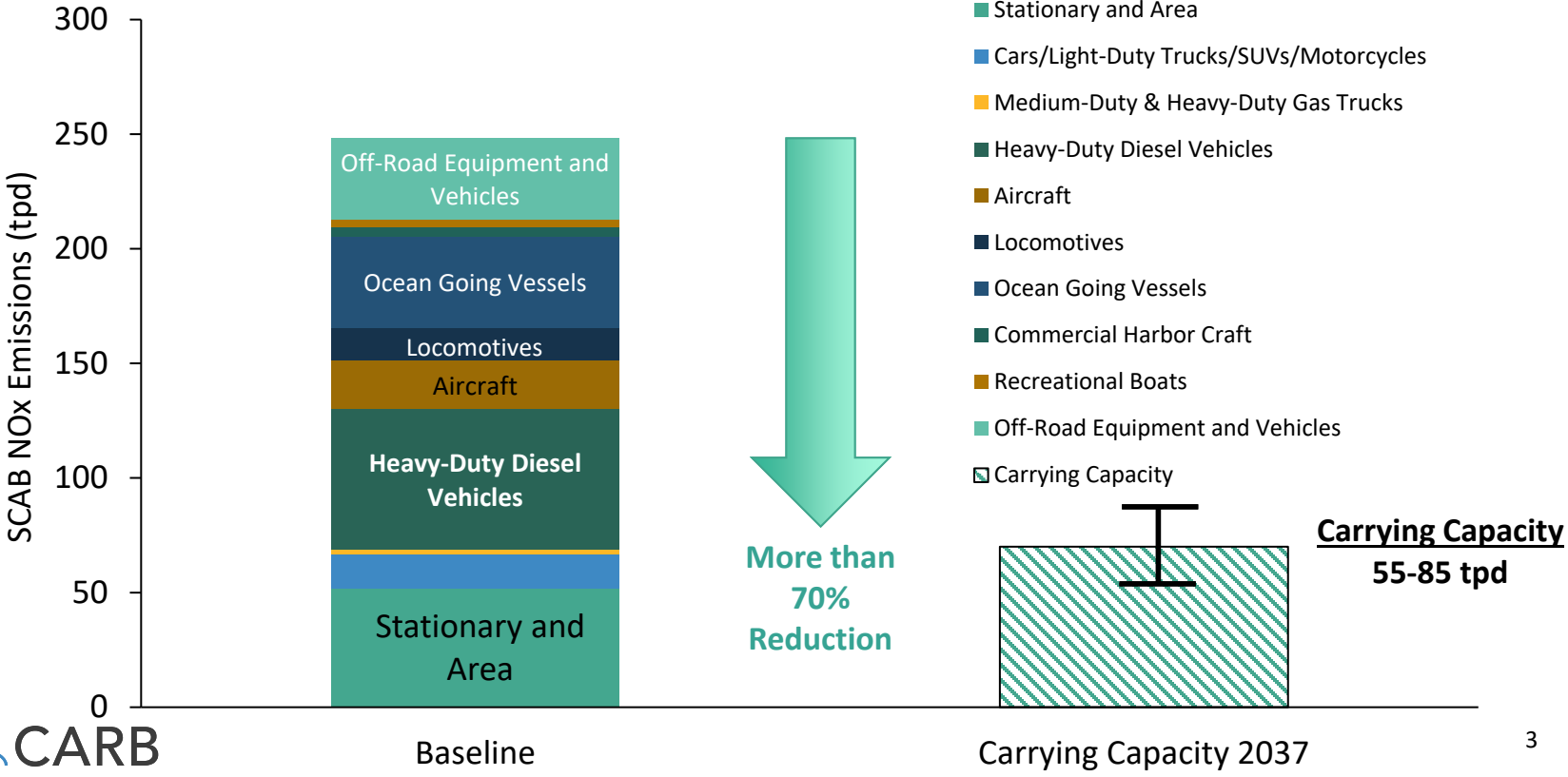
# Major NO<sub>x</sub> and PM<sub>2.5</sub> Emission Reductions Needed

- California has the worst air quality in the nation
- Key challenges
  - San Joaquin Valley – PM<sub>2.5</sub>
  - South Coast & San Joaquin Valley - Ozone
- Heavy-duty trucks and federal sources remain largest contributors
- Action beyond current programs needed by 2031 and 2037
  - Nearly all heavy trucks to have 2010 model year engines by 2023



# South Coast 2037 Attainment

(Working Draft)




# Disadvantaged Community Focus

- Assembly Bill 617 directs CARB to identify community level strategies
- Communities seek action on transportation and freight emissions
- Seek rapid transition to zero-emissions



# Executive Order N-79-20

 **100% ZEV sales** by 2035

Full transition to  
**ZEV short-haul/drayage trucks**   
by 2035

 Full transition to **ZEV buses & heavy-duty long-haul trucks**   
by 2045\*

Full transition to  
**ZE off-road equipment**  
by 2035\*

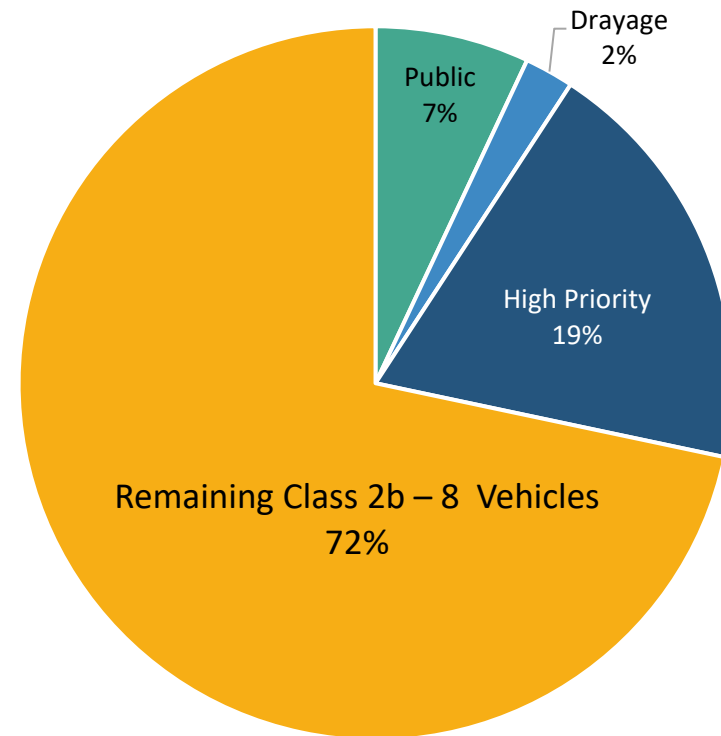
\*where feasible

# Advanced Clean Fleets Overview

- Phase-in zero emission trucks and buses 2023 to 2045\*
  - State and local government fleets
  - High priority private fleets and federal agencies
  - Drayage trucks serving ports and railyards
- Contribute to meeting zero-emission fleet goals where feasible
- Prioritize benefits in disadvantaged communities
- First hearing December 2021

# Affected Vehicles

- Approximately 28 percent of Class 2b – 8 trucks in South Coast air basin will be affected by the ACF Regulation



# Examples of Affected Vehicles

Class 2b-3	Class 4-8	Class 7-8 Tractors
   	   	  



# State and Local Public Fleets

- Cities, counties, special districts, state agencies
- Must purchase ZEVs when adding vehicles to the fleet
  - 50% of purchases for 2024-2026 model year
  - 100% of purchases for 2027 and newer model years
- Three-year exemption if exclusively in designated low population counties
- Exemptions if suitable ZEVs are not available

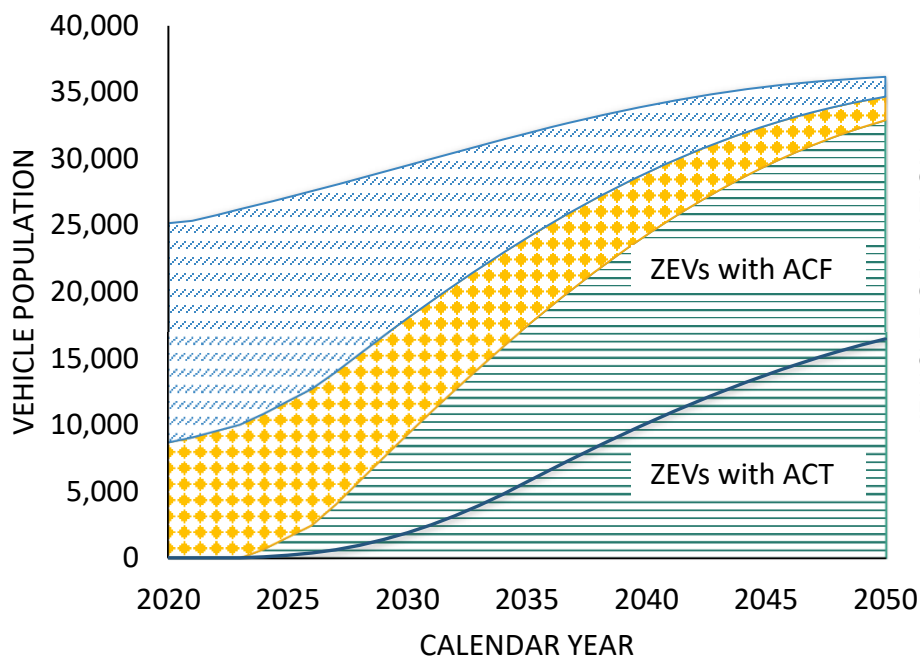


# Emissions Modeling - Public Fleets

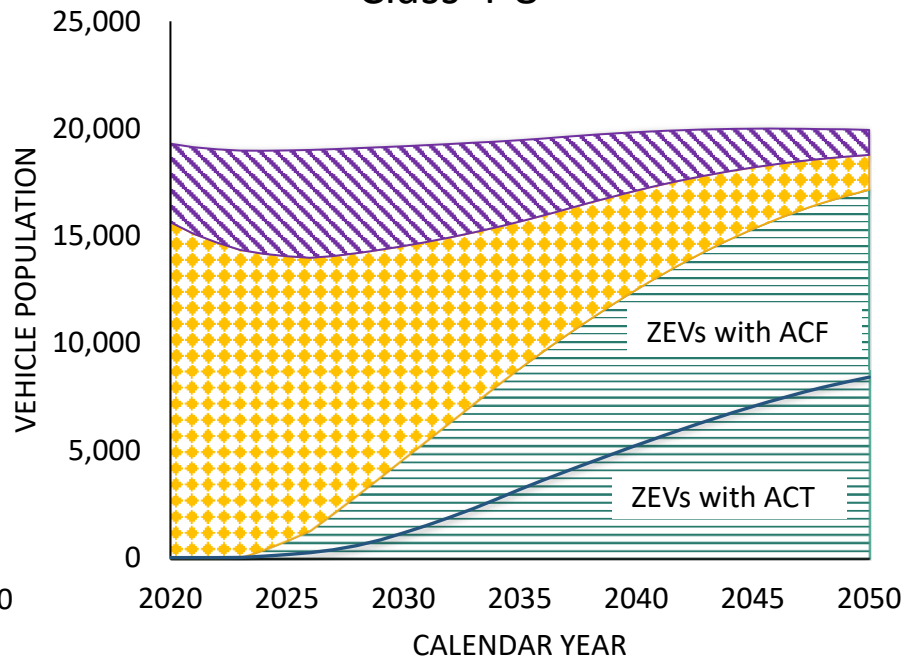
- Class 4-8:
  - EMFAC2021 MHD and HHD public categories
- Class 2b-3, Buses, Class 8 Solid Waste Collection Vehicle:
  - DMV registration data is used to determine the population of exempt plate trucks and buses (excluding transit)
- Applies to new vehicle purchases:
  - 50% ZEV for 2024-2026 model year
  - 100% ZEV for 2027 MY onwards
- Low population municipalities with 3-year delay\*

# Public Fleets ZEV Population

Class 2b-3



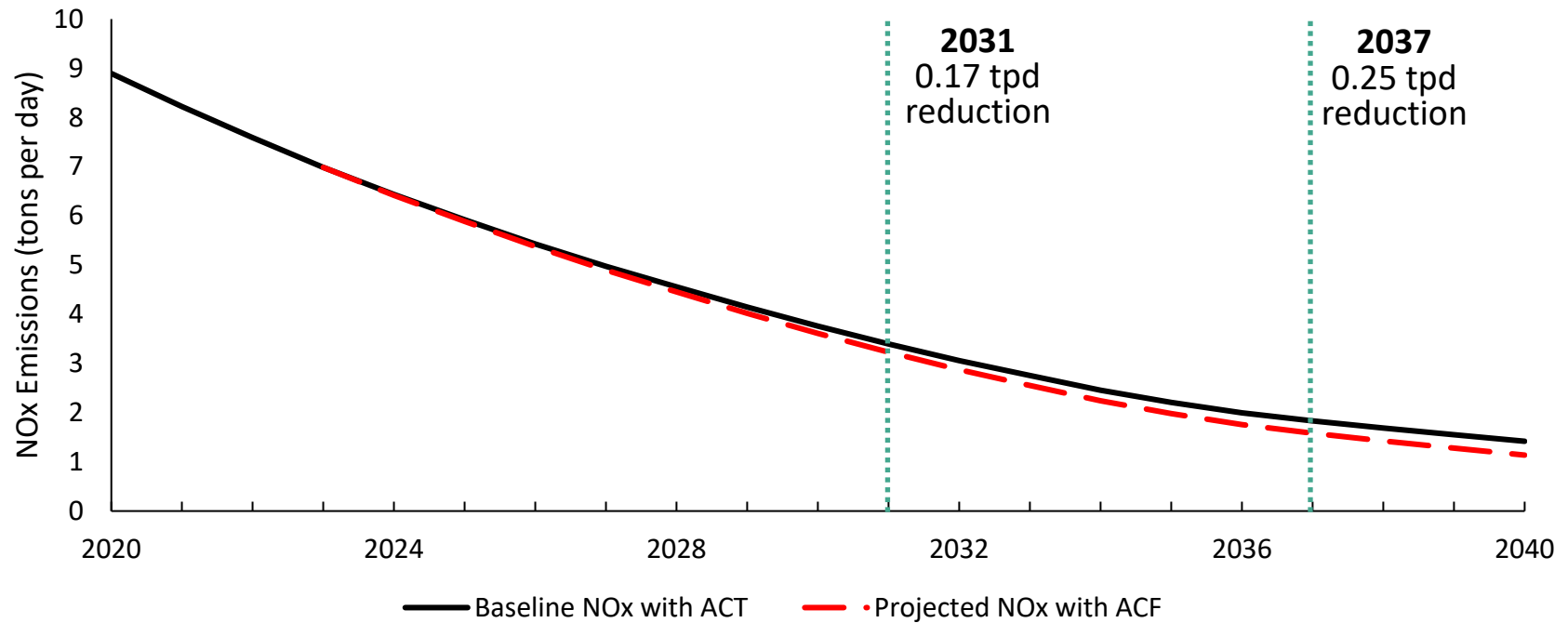
Class 4-8



Zero-Emission Vehicle
  Diesel Vehicles
  Gasoline Vehicles
  Natural Gas Vehicles
  ACT ZEV Population



# Public Fleets NOx Emissions



# Drayage Trucks

- Applies to any truck entering intermodal seaports or railyards
- Beginning in 2023, any truck added to the CARB Drayage Truck Registry must be zero-emissions
- Legacy drayage service ends when engine model is 13 years old or 800,000 miles, whichever comes last (no more than 18 years)
- Complete transition to zero-emissions by 2035



Zero Emission Drayage Trucks by 2035



## Calendar Year 2019/2020 Statewide Drayage Truck Inventory

Vehicle Category	Port of Oakland (POAK)	Port of LA/LB (POLA)	Other Seaports*	Railyards**
Instate Class 8 <sup>†</sup> <i>Active Trucks</i> ***	4,224 <sup>‡</sup>	13,951 <sup>‡</sup>	1,453 <sup>‡</sup>	TBD
Instate Class 8 <sup>†</sup> <i>Inactive Trucks</i> ***	n/a***	2,770		
Instate POAK Class 8 already in POLA <sup>†</sup>	136			
Class 4-7 <sup>†</sup>	22	180		
Out of State <sup>†</sup>	823	854		
<b>Total</b>	<b>5,205</b>	<b>17,755</b>	<b>1,453</b>	<b>TBD</b>

<sup>†</sup> Non-gasoline

<sup>‡</sup> T7 POLA Class 8, T7 POAK Class 8, and T7 Other Ports Class 8 in EMFAC202x

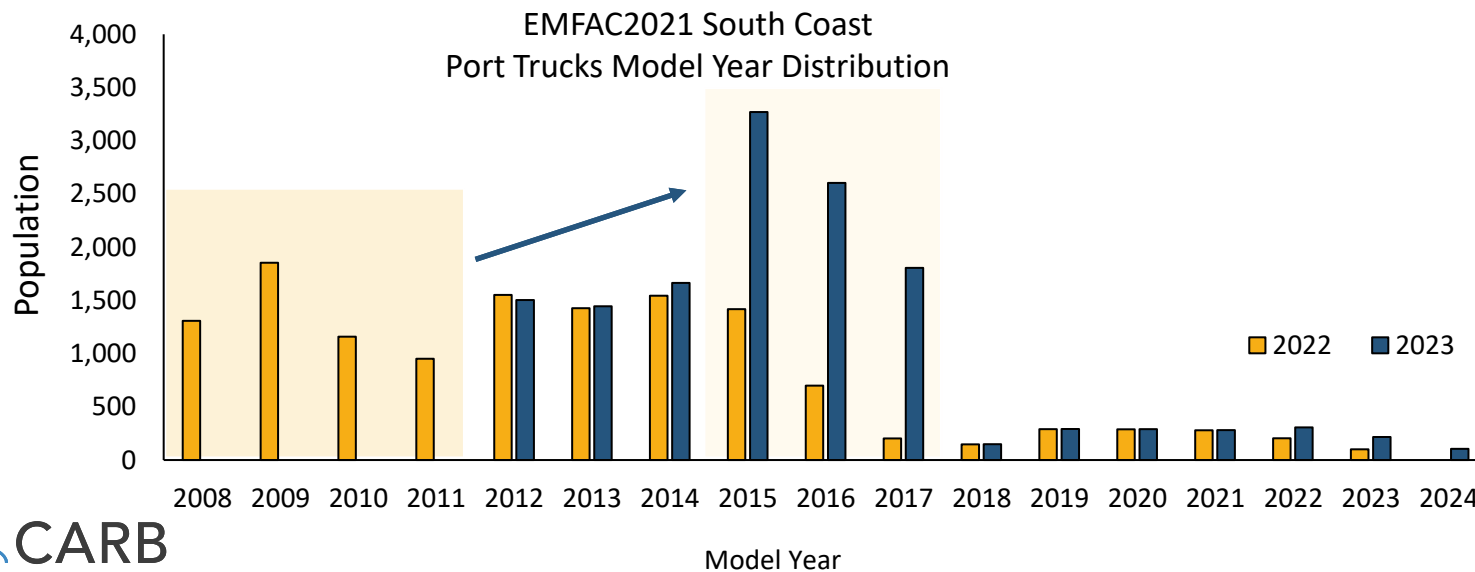
\* Estimate based on past Surveys; Requesting updated information from other seaports

\*\* UP and BNSF have provided an initial analysis of truck counts at various railyards in California, and staff are analyzing those for inventory purposes

\*\*\* For POLA, trucks with more than 112 visits/year are considered as "active trucks". 112 visit/year was determined based on POLA monthly active truck counts. POAK did not provide monthly visit data and therefore all of their class 8 in-state trucks were considered active.

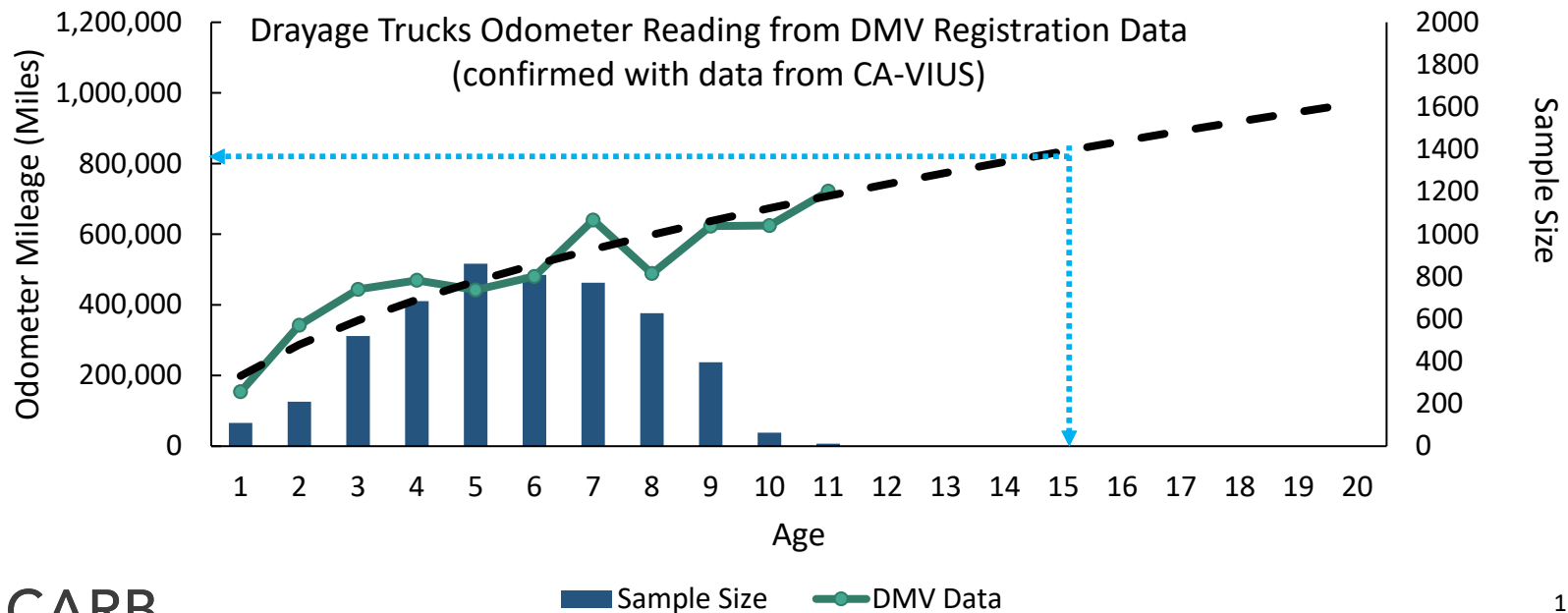
# South Coast Drayage Truck Population in EMFAC2021

- EMFAC2021 baseline inventory assumes used truck purchases prior to 2023 as a result of Truck & Bus rule
- The 2023 baseline inventory is used to project emissions benefit of ACF Drayage requirements



# Emissions Modeling – Drayage Fleets

- Legacy drayage fleet: Assumed to be removed from registry when engine age exceeds 15 years

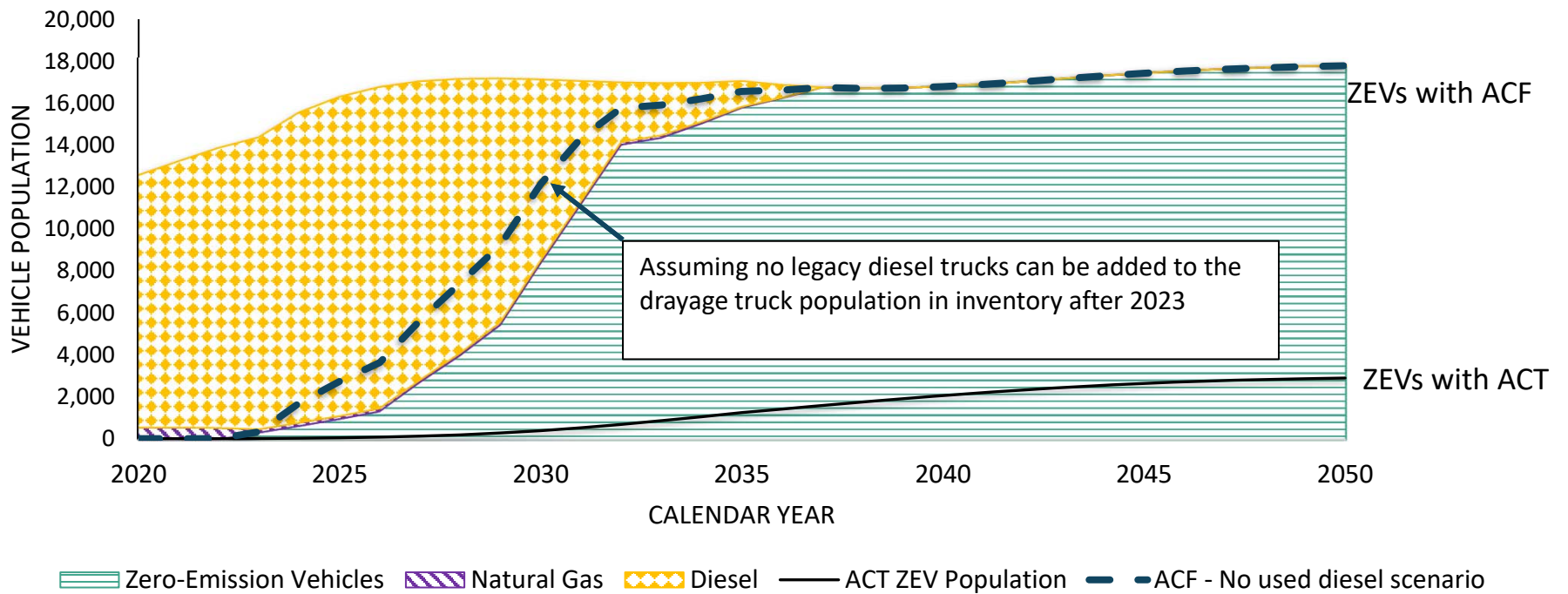




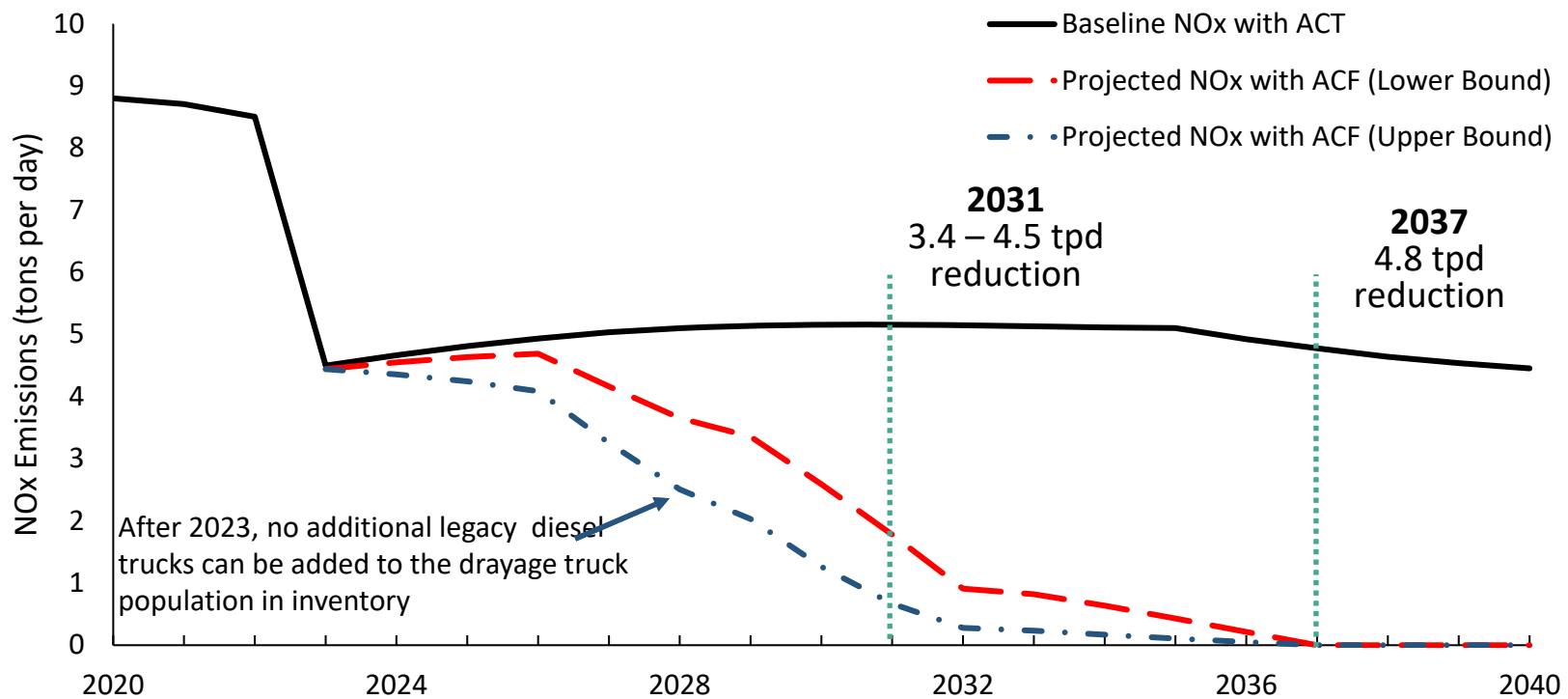
# ACF Drayage Scenarios

- **Baseline ACF Scenario:** All new drayage trucks of MY 2023+ are ZEVs from CY2023
- **Additional scenario regarding the legacy fleet:** Trucks must visit a California seaport or railyard at least once in 2023, to remain in CARB Drayage Truck Registry

# SC Port Trucks ZEV Population



# SC Port Trucks NOx Emissions



- Emission benefits are above and beyond ACT/HD Omnibus
- Staff will further revise this analysis using truck data recently provided by railroads.

# Private and Federal Fleets

- Includes retailers, manufacturers, construction companies, telecoms, utilities, and others that own or dispatch vehicles
- High priority private fleets
  - > \$50 million revenue and own at least one truck
  - Own or direct >50 trucks (includes any subhaulers)
- Federal agencies with at least one truck



# ZEV Milestone Phase-In Schedule

- High priority private and federal fleets milestones
  - Percentage of the total fleet must be zero emission
  - Flexibility to meet targets across categories
- Exemptions if suitable ZEVs are not available

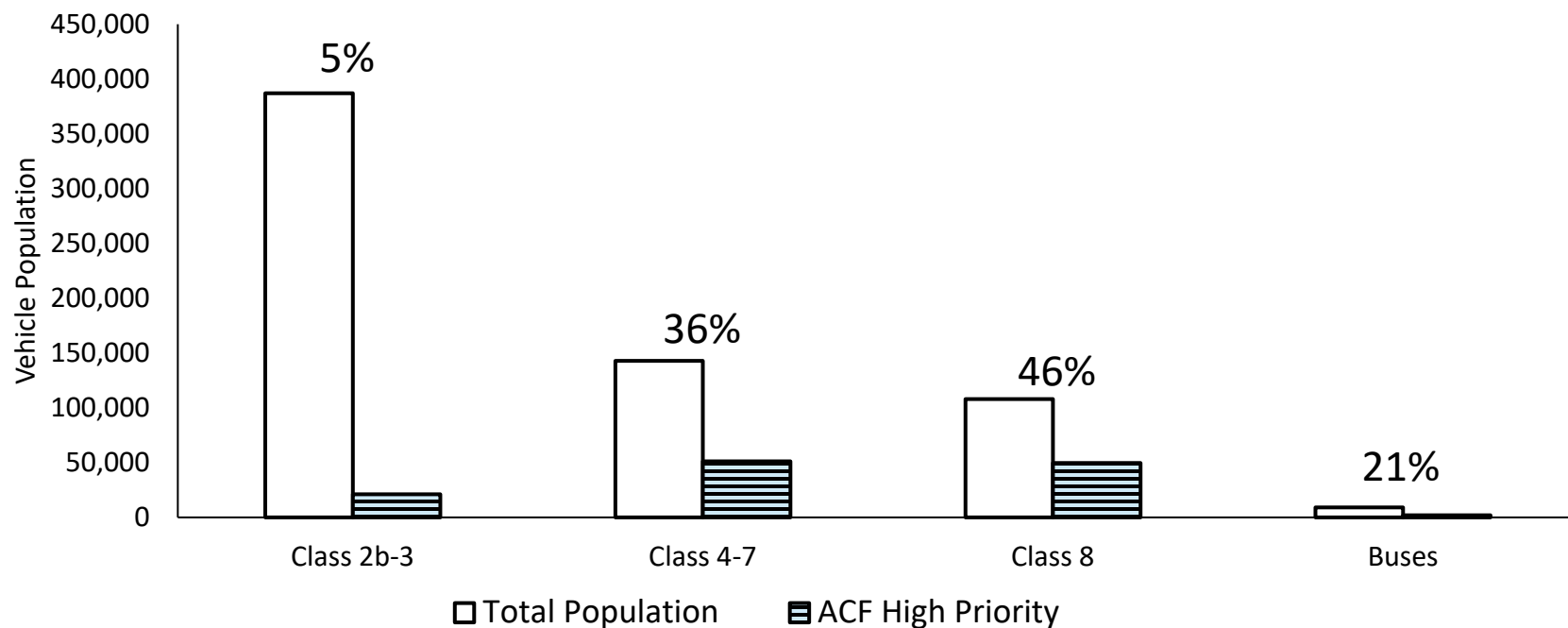
Zero-Emission Fleet Percentage	10%	25%	50%	75%	100%
Box trucks, vans, two-axle buses, yard trucks	2025	2028	2031	2033	2035
Work trucks, day cab tractors, three-axle buses	2027	2030	2033	2036	2039
Sleeper cab tractors and specialty vehicles	2030	2033	2036	2039	2042

## Emissions Modeling - High Priority Fleets

- High priority fleets identification:
  - Entities with more than \$50 million annual revenue that operates at least one vehicle in California were determine using Dun & Bradstreet database
  - Entities that own more than 50 vehicles were determine using DMV & IRP Registration database
  - Will be further refined based on the Large Entity Reporting in April 2021
- ZEV fractions between the phase-in target years are linearly interpolated

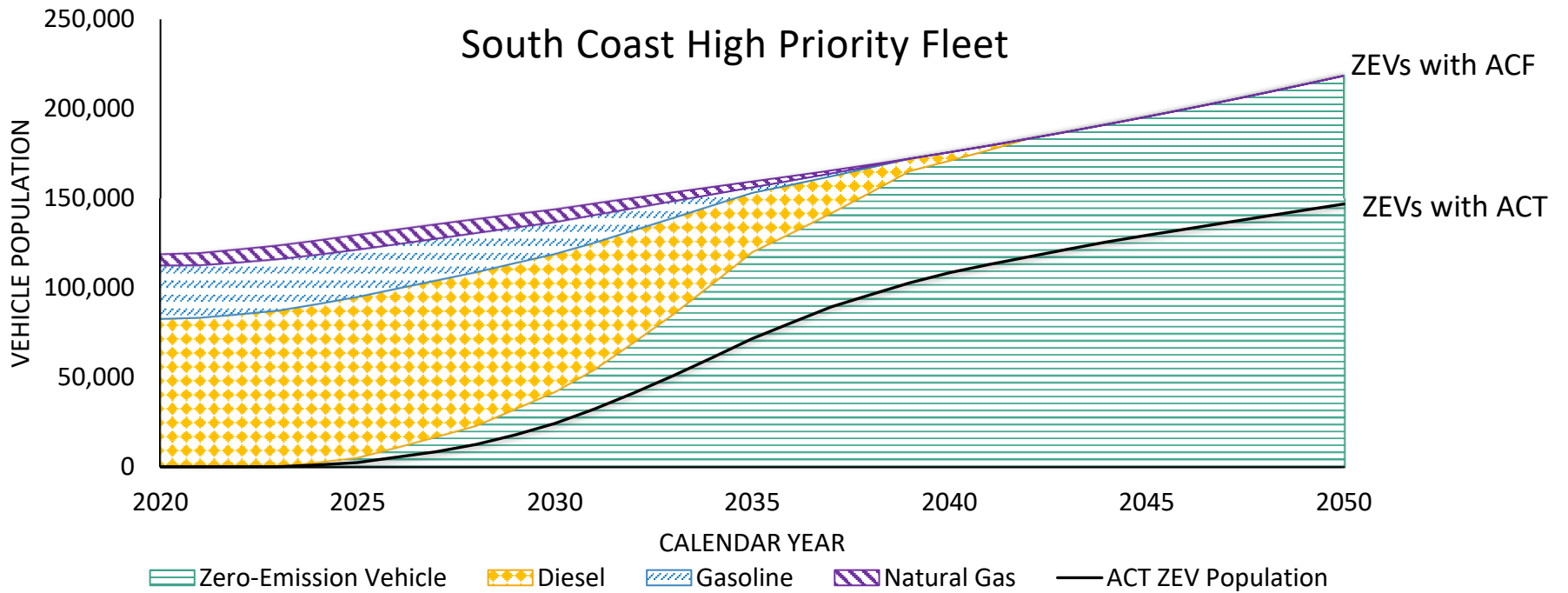


# High Priority Fleets in South Coast



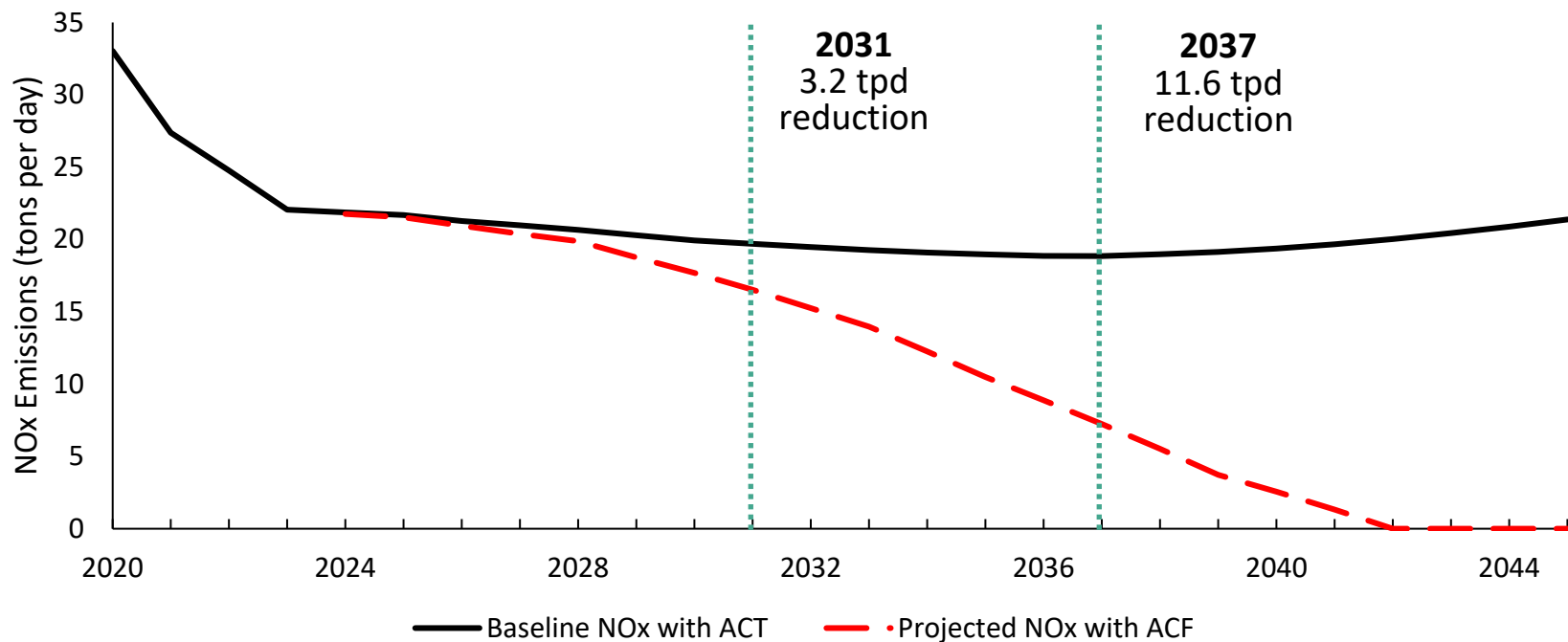
Note: These are preliminary estimates based on CA DMV & IRP Registration and Dun & Bradstreet databases and the numbers are subject to change upon availability of Large Entity Reporting

# High Priority Fleets ZEV Population





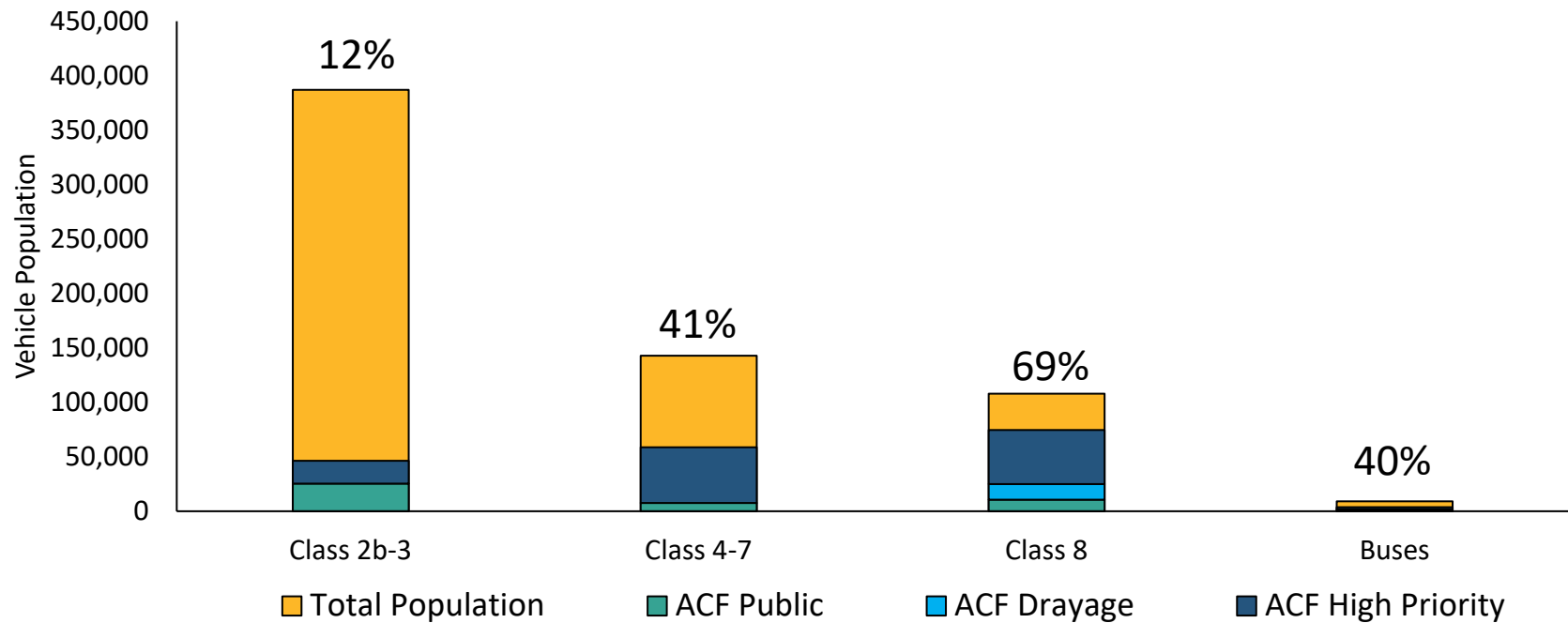
# High Priority Fleets NOx Emissions in South Coast





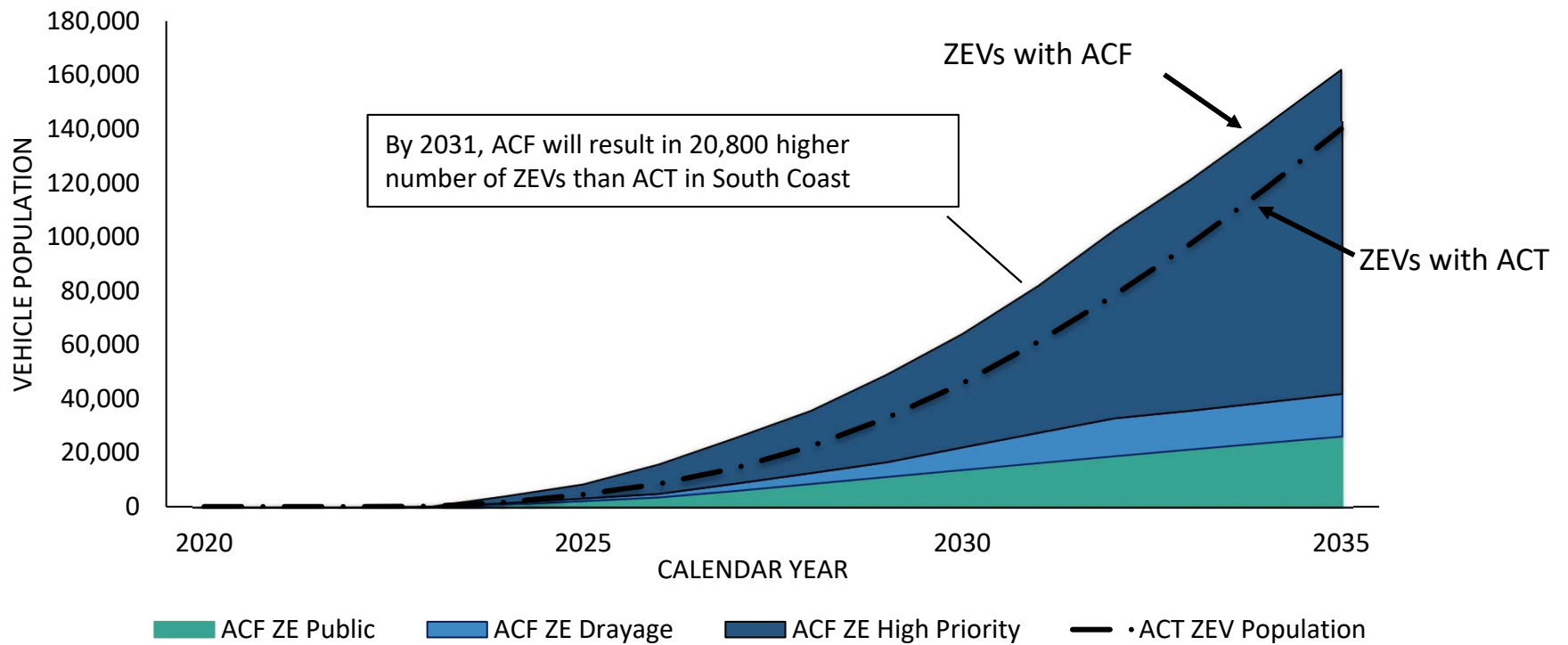
# Summary of Emissions Reductions

# Vehicles Affected by Advanced Clean Fleets in South Coast



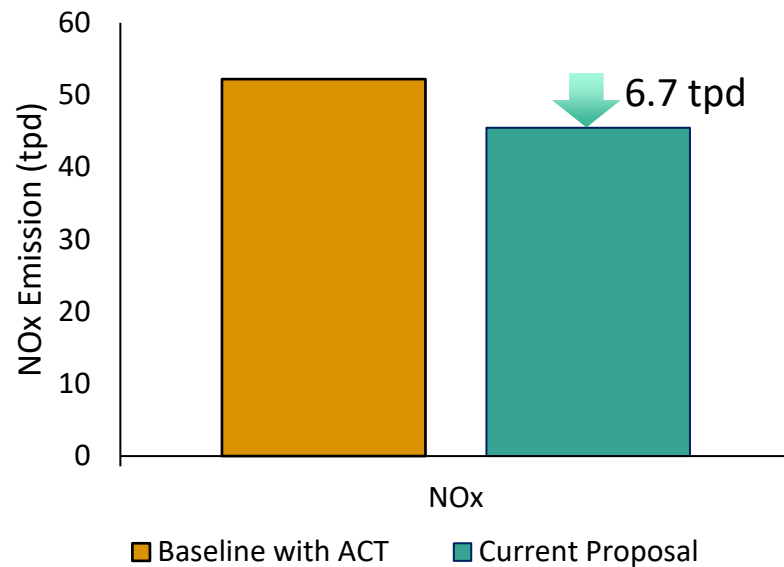
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# ZEV Population Comparison

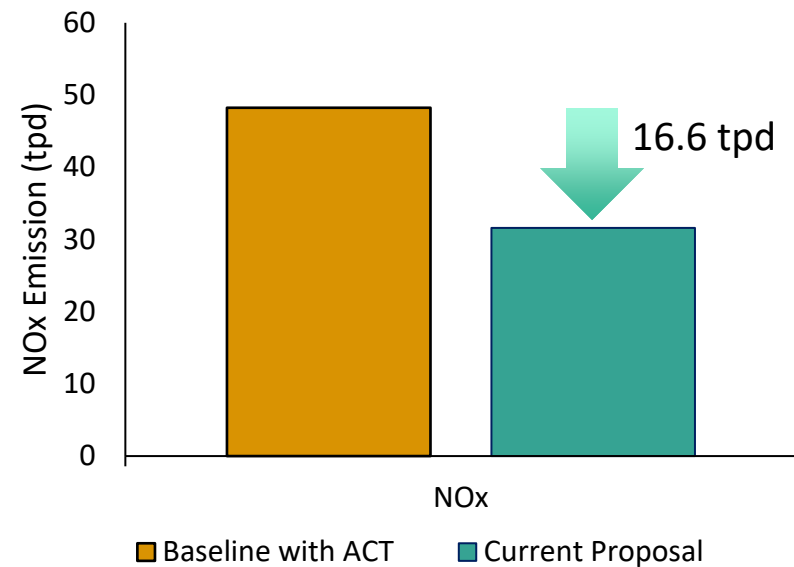


# Emission Benefits from ACF

South Coast NOx Emission from All Class 2b-8 Vehicles in **2031**



South Coast NOx Emission from All Class 2b-8 Vehicles in **2037**



# Caveats

- The current estimate of high priority fleets is missing the sub-haulers since it was not feasible to identify them through DMV or Dun & Bradstreet databases
- Several stakeholders have indicated that the high priority fleet percentages used for the inventory are most likely a “lower bound” estimate
- Staff conducted a sensitivity analysis by adjusting the fraction of high priority fleet to illustrate a potential “upper bound” estimate
- With twice the number of trucks in priority fleets, NOx emission reductions will increase to 10.5 tpd and 24 tpd in 2031 and 2037, respectively.

## Next Steps

- Continue individual meetings with fleets and stakeholders
- Continuing workshops/workgroups throughout this year
- Receive fleet reported data April 2021
- Continue refining emissions benefit assessment for priority fleets as well as drayage trucks operating at railyards
- Rule recommendation to Board in December 2021

## For More Information

- Visit CARB's website at: <https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets>
- Subscribe to receive ACF email updates at: [https://public.govdelivery.com/accounts/CARB/subscriber/new?topic\\_id=zevfleet](https://public.govdelivery.com/accounts/CARB/subscriber/new?topic_id=zevfleet)

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# Cleaner Trucks Initiative: Program Overview and Advanced Emission Control Testing

March 24, 2021  
AQMP Mobile Source Working Group

Brian Nelson  
US EPA - Office of Transportation and Air Quality

# Outline

- ▶ Overview of Major Provisions Under Consideration
- ▶ Engine Demonstration Testing
  - ▶ Diesel
  - ▶ Gasoline
- ▶ Accelerated Aging Protocol Validation
- ▶ Next steps & discussion

# Overview of Major Program Provisions Under Consideration

- ▶ Standards and Test Cycles
- ▶ In-Use Emission Standards
- ▶ Extending the Regulatory Useful Life
- ▶ Ensuring Long-Term In-Use Emissions Performance
- ▶ Technologies & testing @ NVFEL
- ▶ Certification and Compliance Streamlining

# Standards and Test Cycles

## ▶ Improving Existing Emission Standards

- ▶ Technologies being considered should enable significant emission reductions

## ▶ New Emission Test Cycles and Standards

- ▶ Considering the addition of a low-load test cycle and standard to improve performance of the emission control system at low load and low temperature operation



# In-Use Emission Test Procedures & Standards

- ▶ Significant in-use performance improvements can be made by considering more of the engine operation outside of today's EPA in-use testing requirements
- ▶ ANPR describes the intent of the CTI to improve our in-use procedures to capture nearly all real-world operation
- ▶ Evaluating a revised in-use approach, including:
  - ▶ Using an approach similar to the Euro VI in-use program
  - ▶ That divides in-use operation into 3 bins to set unique standards for each type of operation
  - ▶ EPA will be evaluating emission measurement uncertainty of the measurement equipment and test procedure



# Extending the Regulatory Useful Life



- ▶ Today's regulatory useful life covers less than half of the primary operational life (i.e. time to first engine rebuild) for most heavy-duty engines
  - ▶ Today's useful life ranges between 110,000 and 435,000 miles, depending on the regulatory class
  - ▶ EPA data indicates that the average engine rebuild mileage for those classes range between 315,000 and 910,000 miles
- ▶ ANPR requested comment on issues related to extended useful life requirements such as:
  - ▶ Appropriate useful life values
  - ▶ Considerations for durability demonstrations
  - ▶ Useful life of aftertreatment components
  - ▶ How many times engine cores are typically rebuilt

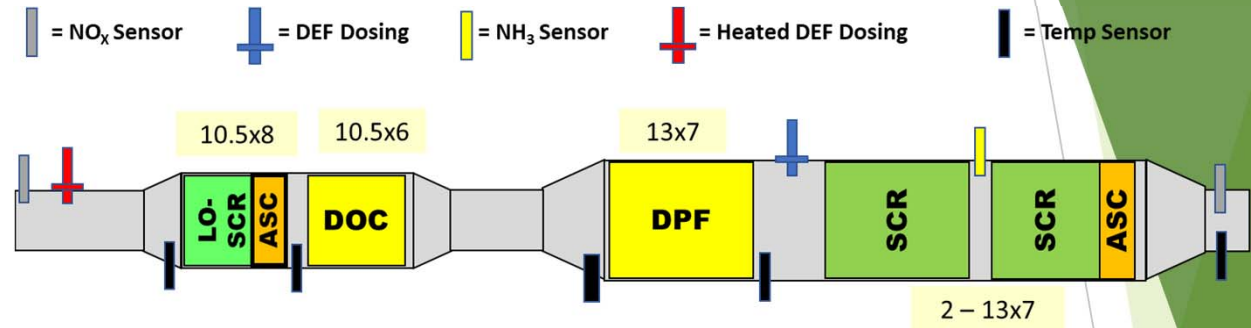
# Ensuring Long-Term In-Use Emissions Performance

- ▶ Deterioration of emission controls can increase emissions from in-use vehicles
- ▶ Such deterioration can be inherent to the design and/or materials of the components; the result of component failures; or the result of mal-maintenance or tampering
- ▶ The ANPR sought comment on ways to develop a modern strategy to improve real-world in-use emissions performance, including:
  - ▶ Warranties that cover an appropriate fraction of engine operational life
  - ▶ Improved, more tamper-resistant electronic controls
  - ▶ Serviceability improvements for vehicles and engines
  - ▶ Education and potential incentives
  - ▶ Engine rebuilding practices that ensure emission controls are functional

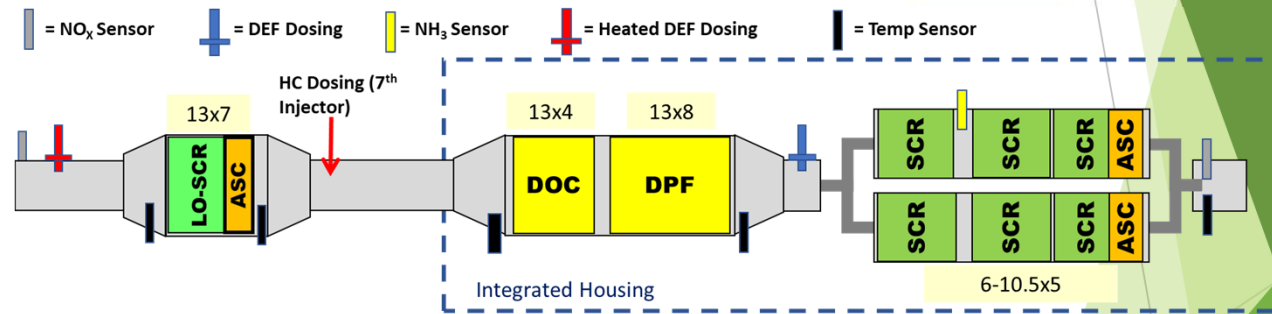


# CTI—Technologies to Reduce NOx Emissions (testing @ EPA's NVFEL)

## ► Dual SCR



## ► Cylinder deactivation (CDA)





# In-Vehicle CDA Testing @ NVFEL

Engine: Cummins X15 w/prototype CDA hardware and a dynamometer-developed control strategy

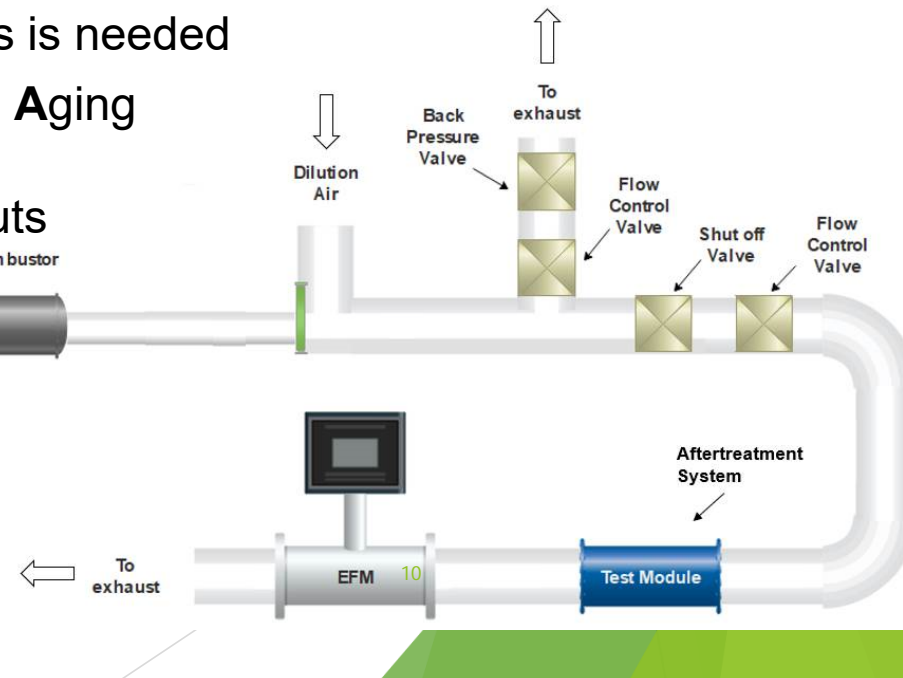
Chassis: 2018 Navistar LT625 w/manual transmission

- ▶ Measure emission and exhaust temperature impact of various CDA strategies under common load scenarios & test cycles
- ▶ Quantify the NVH impact of CDA using engine- and cab-mounted accelerometers to measure vibration frequencies and forces



# CTI—Streamlining Process for Aftertreatment System Aging

- Increasing emissions useful life beyond 435K miles = increased time to dyno age parts, which has impact on certification:
  - Time (risks stifling technology advancement)
  - Cost (unnecessary burden if a cheaper—*yet representative*—alternative exists)
- CARB and EPA agree that a new aging process is needed
- EPA is validating a **Diesel Aftertreatment Rapid Aging Protocol (DARAP)** as a method for generating durability cycles based on operational data inputs
  - Adapts to any engine platform
  - Target is a 10X acceleration
- DARAP is being validated for mix of engine- and burner-based approaches, providing mfrs. maximum flexibility



# Next Steps

- ▶ Career team is actively working to support future low-NOx standards
  - ▶ Engaging in a robust and open dialogue with stakeholders
  - ▶ Furthering our own research with dynamometer- and chassis-based test programs
  - ▶ Continued aging & testing of CARB's "Stage 3" aftertreatment system beyond 435K miles
- ▶ Engaging with new EPA leadership on future HD criteria and GHG emission standards

# EPA Contacts for CTI

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