CALIFORNIA
AIR RESOURCES BOARD

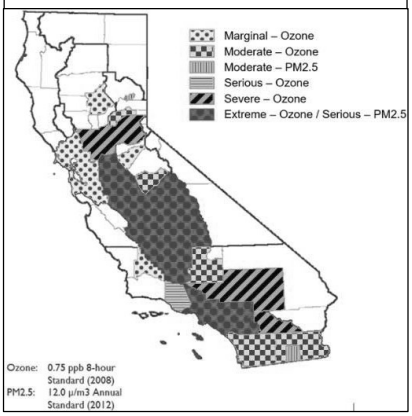
Advanced Clean Fleets Regulation

2022 AQMP Mobile Source Working Group
Heavy-Duty Trucks (Meeting #2)
March 24, 2021

Major NOx and $PM_{2.5}$ Emission Reductions Needed

- California has the worst air quality in the nation
- Key challenges
  - San Joaquin Valley – PM2.5
  - 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

California Ozone and PM2.5 Non-Attainment Areas



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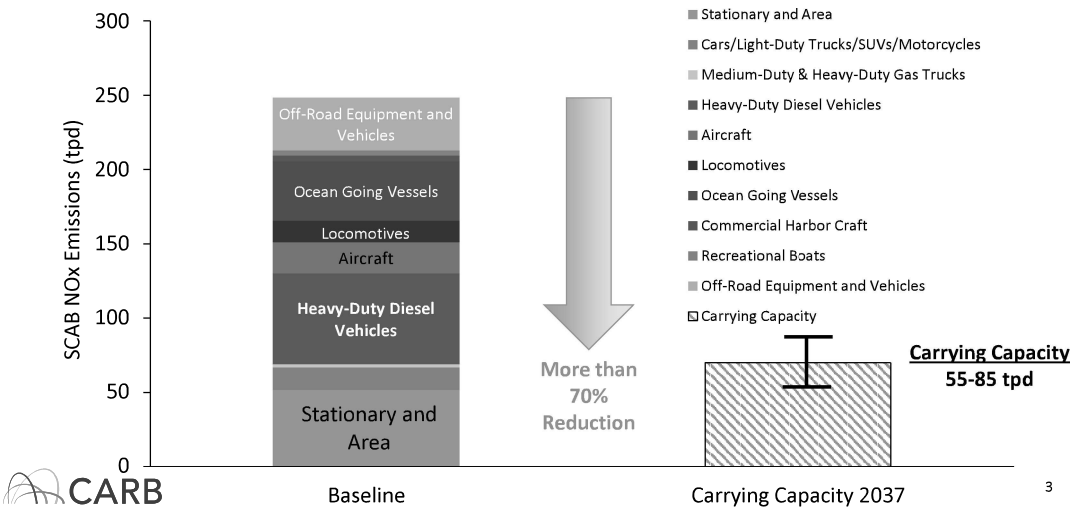
South Coast 2037 Attainment

(Working Draft)



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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

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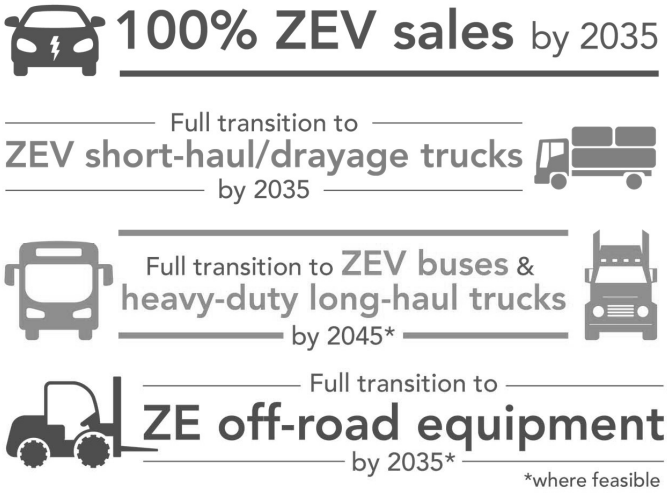
Executive Order N-79-20



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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

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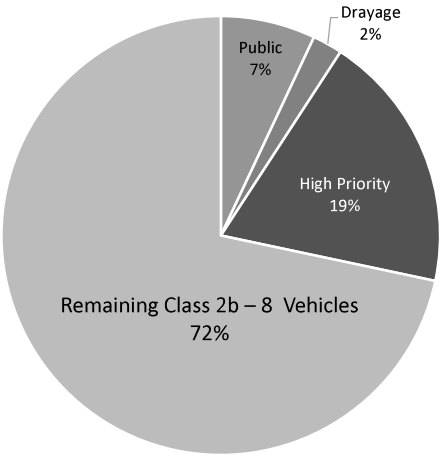
*Applies to on-road vehicles with a gross vehicle weight rating >8,500 lbs. and off-road yard tractors

Affected Vehicles

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



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Note: These are preliminary estimates based on CA DMV & IRP Registration as well as Dun & Bradstreet databases and the numbers are subject to change upon availability of Large Entity Reporting. These numbers do not yet include truck counts from intermodal railyards nor the number of subhaulers affected.

Examples of Affected Vehicles

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

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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

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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*

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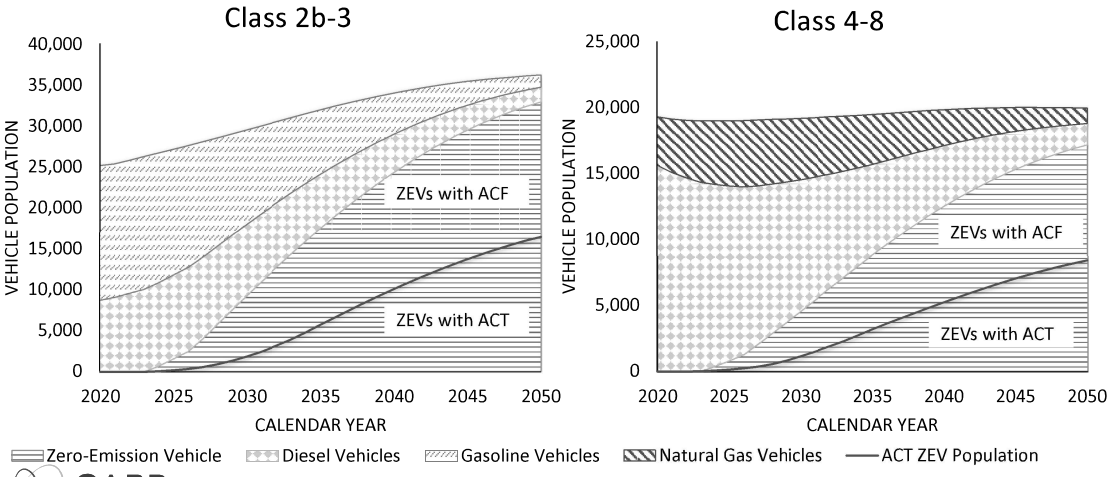
* Demographic data acquired from https://www.california-demographics.com/counties_by_population

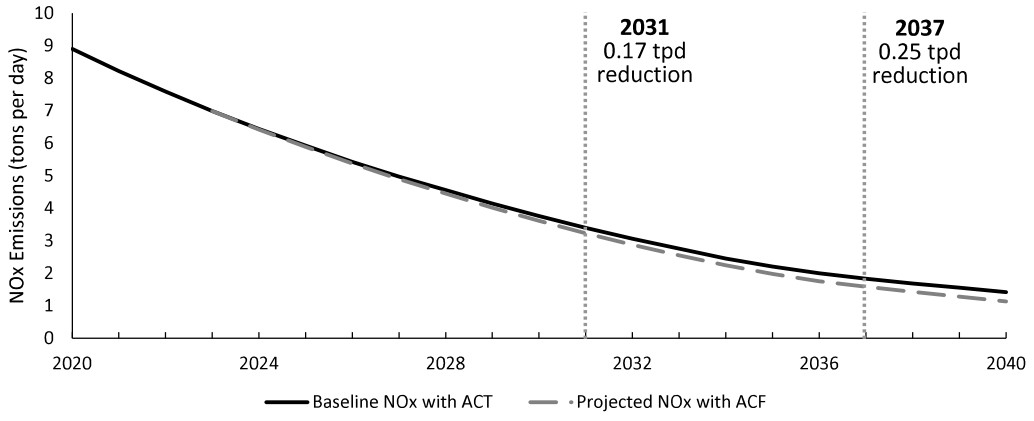
State and Local Public Fleets

Public Fleets ZEV Population



State and Local Public Fleets

Public Fleets NOx Emissions



Emission benefits are above and beyond ACT/HD Omnibus

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

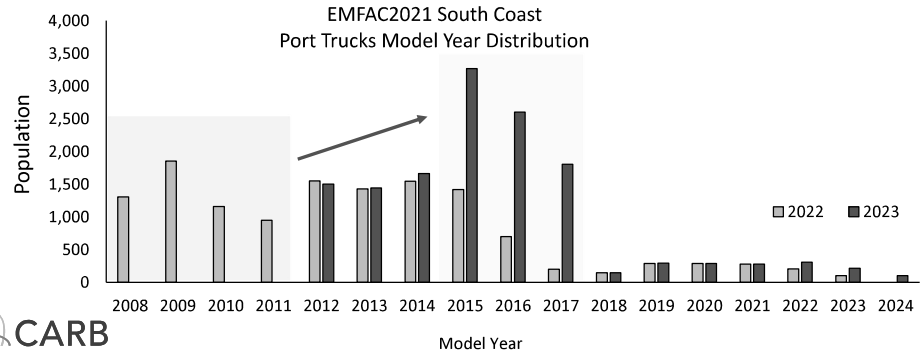
Calendar Year 2019/2020
Statewide Drayage Truck Inventory

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

† *Non-gasoline*
‡ *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.*

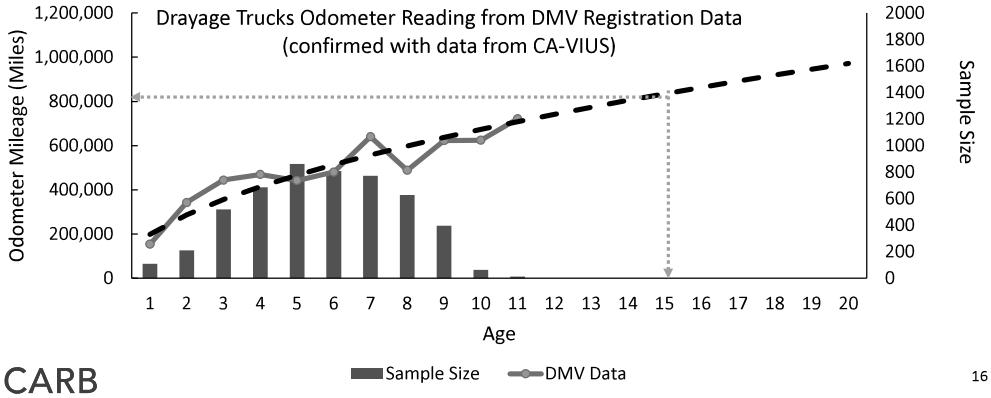
South Coast Drayage Truck Population in EMFAC2021

- 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

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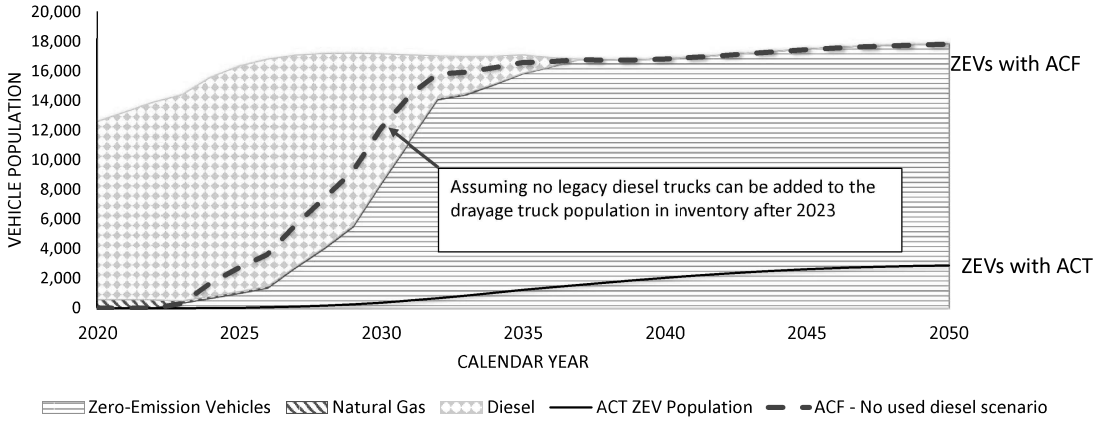
Drayage

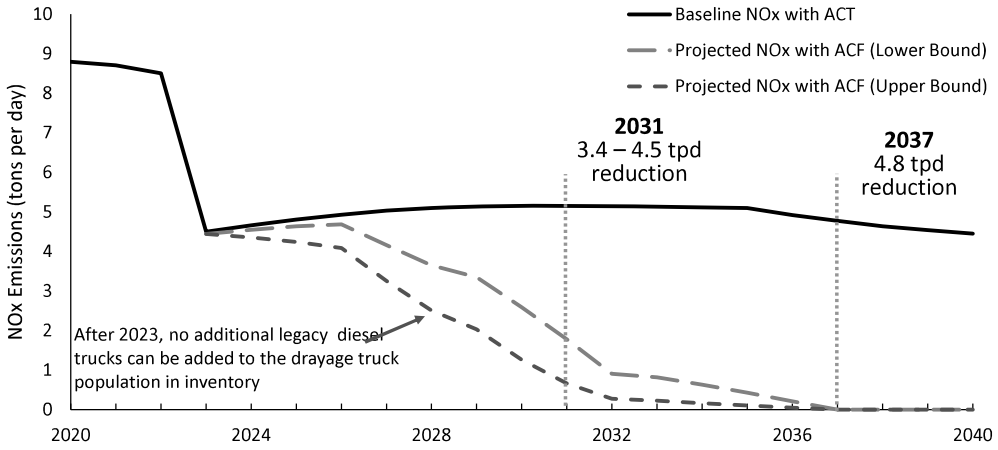
SC Port Trucks ZEV Population



CARB Staff will further revise these estimates using truck data recently provided by railroads.

Drayage

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

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

Private and Federal

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

CARB "Work truck" means any single-unit vehicle that is not a box truck, van, or bus

Private and Federal

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

dun & bradstreet
GROWING RELATIONSHIPS THROUGH DATA

INTERNATIONAL REGISTRATION PLAN, INC.

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

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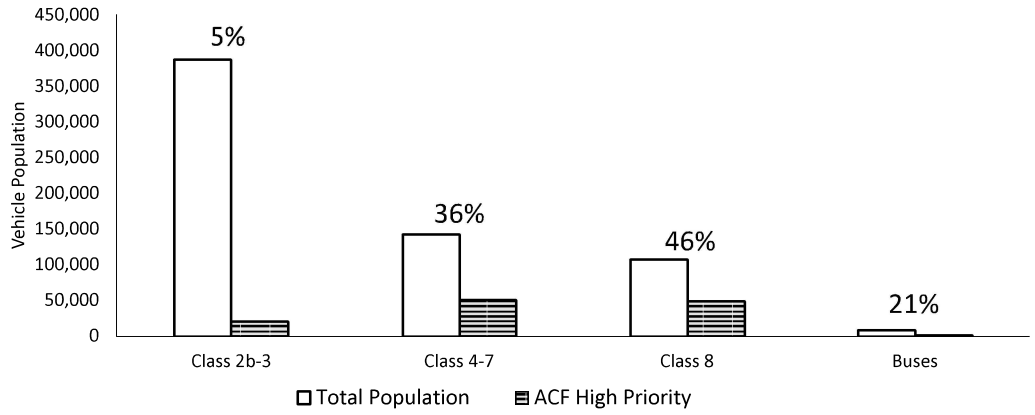
Private and Federal

High Priority Fleets in South Coast



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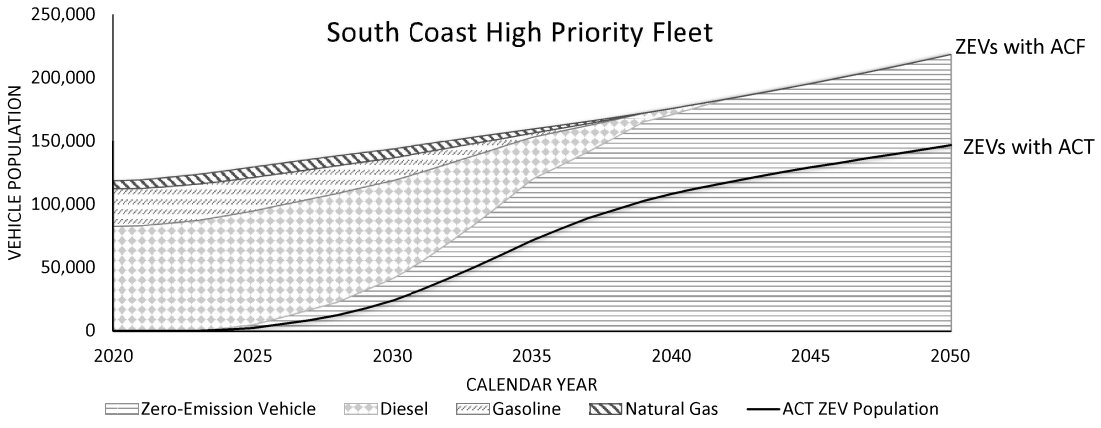
Private and Federal

High Priority Fleets ZEV Population



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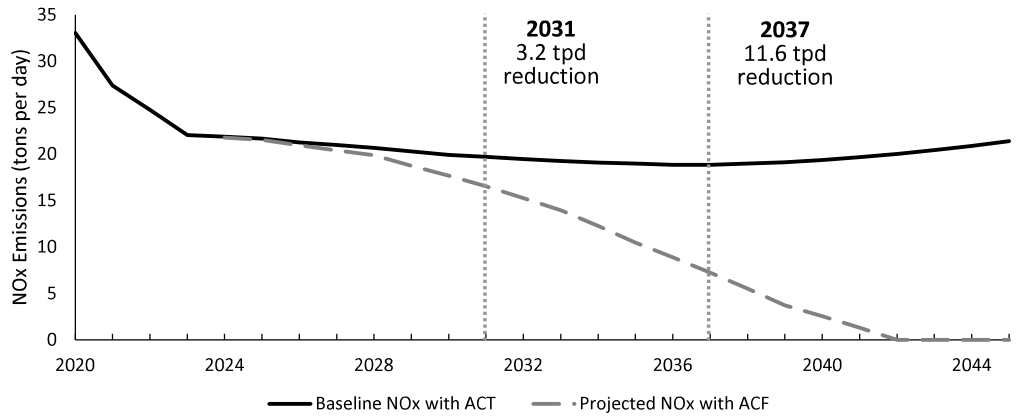
Private and Federal

High Priority Fleets NOx Emissions in South Coast



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Emission benefits are above and beyond ACT/HD Omnibus

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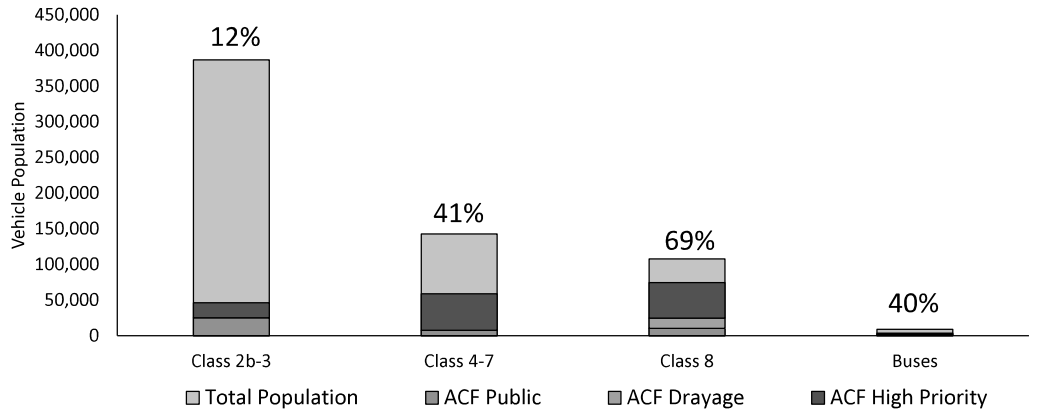
Summary of Emissions Reductions

Vehicles Affected by Advanced Clean Fleets in South Coast



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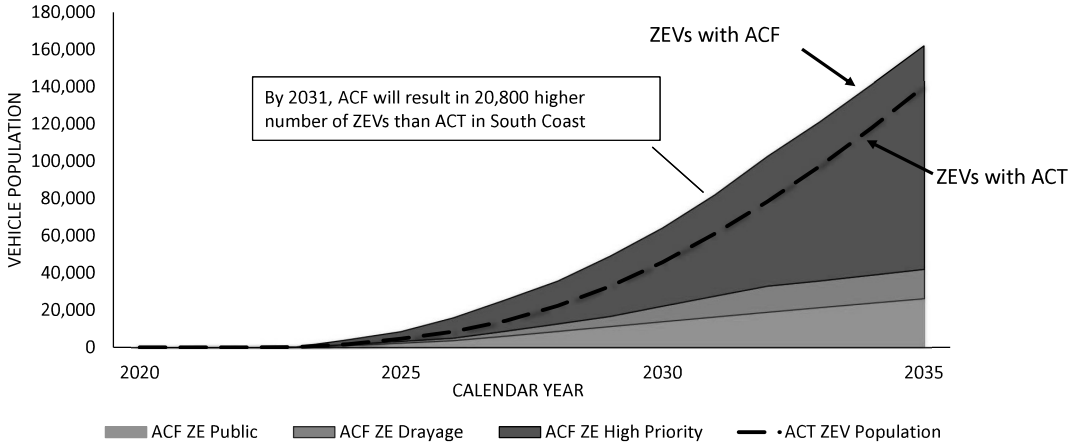
ZEV Population Comparison



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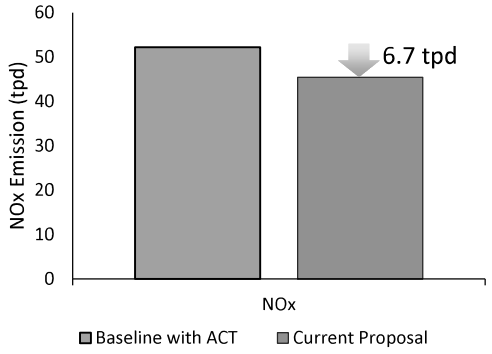
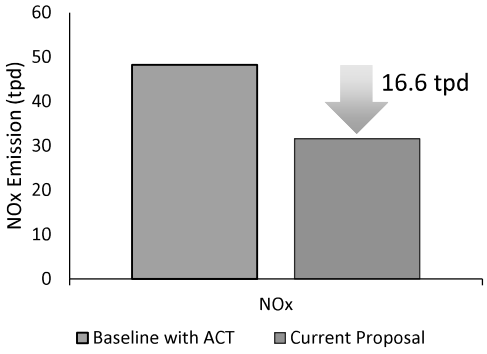
Projection based on EMFAC 2021 Class 2b-8 data

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**



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Emission benefits are above and beyond ACT/HD Omnibus

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.

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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

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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

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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

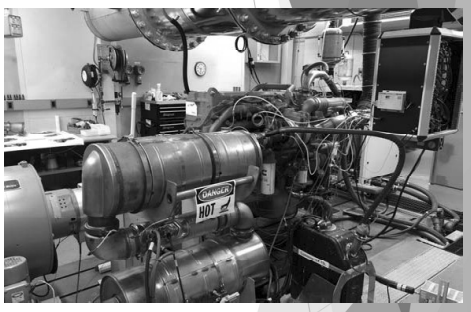
- Overview of Major Provisions Under Consideration
- Engine Demonstration Testing
  - Diesel
  - Gasoline
- Accelerated Aging Protocol Validation
- Next steps & discussion

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

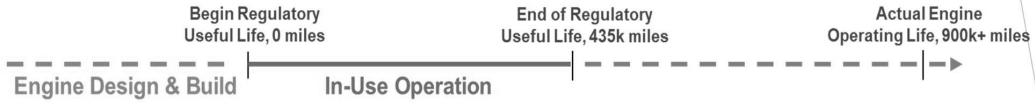
- <u>Improving Existing Emission Standards</u>
  - Technologies being considered should enable significant emission reductions
- <u>New Emission Test Cycles and Standards</u>
  - Considering the addition of a low-load test cycle and standard to improve performance of the emission control system at low 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

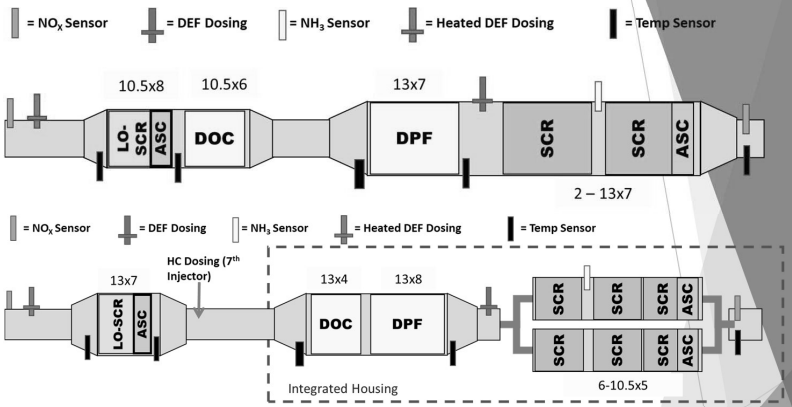
Ensuring Long-Term In-Use Emissions Performance

- 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

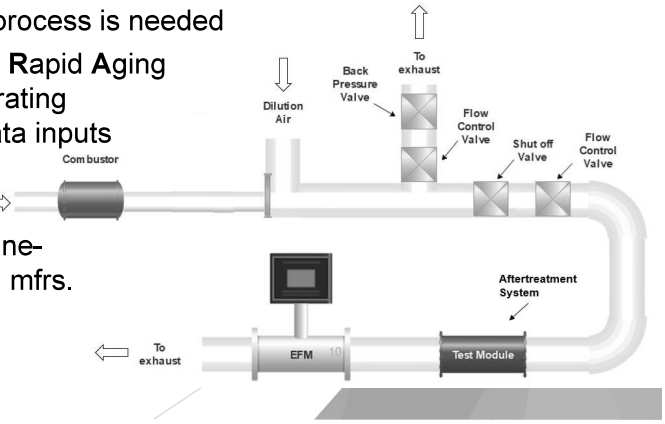
Engine: Cummins X15 w/prototype CDA hardware and a dynamometer-developed control strategy

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 **D**iesel **A**ftertreatment **R**apid **A**ging **P**rotocol (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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