



CALIFORNIA
AIR RESOURCES BOARD

HD Omnibus Rulemaking Update

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NACAA Mobile Sources and Fuels Committee Call

March 26, 2019

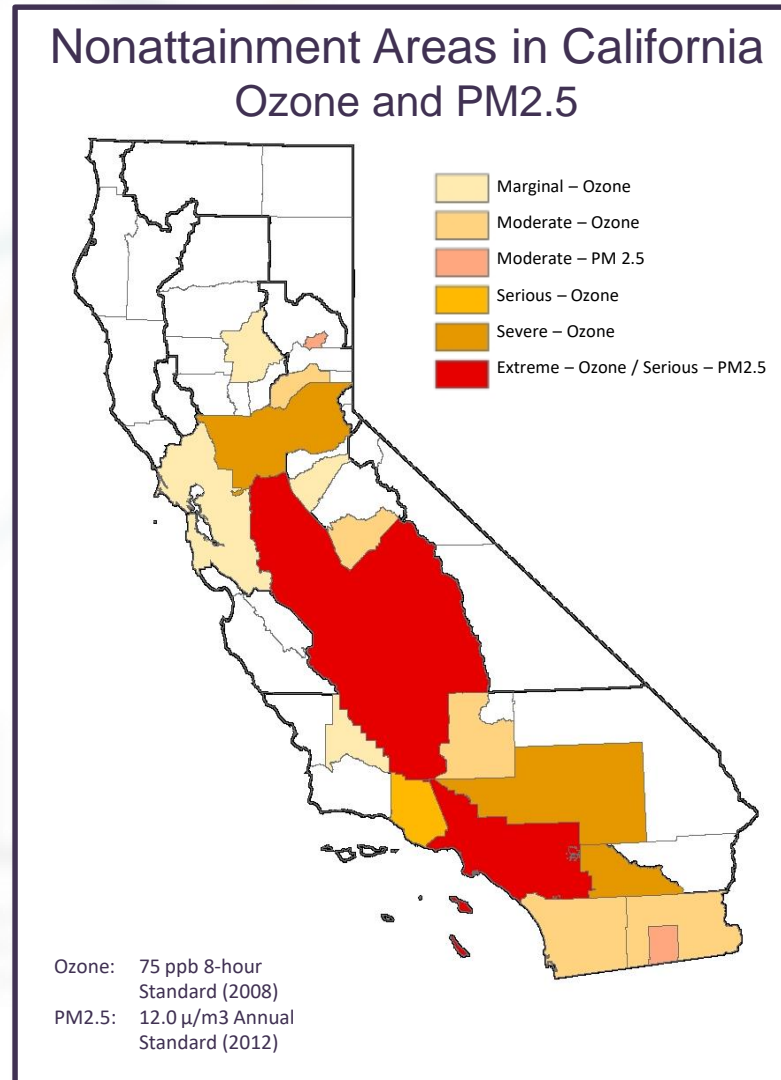
- Background: types of motivating data
- Technology Demonstration work
- Basic thrusts of the Omnibus rulemaking
- Timeline

- Q/A

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Progress, but still issues in California today

- Over 12 million Californians breathe unhealthy air
- Key challenges:
 - South Coast Ozone
 - San Joaquin Valley PM2.5



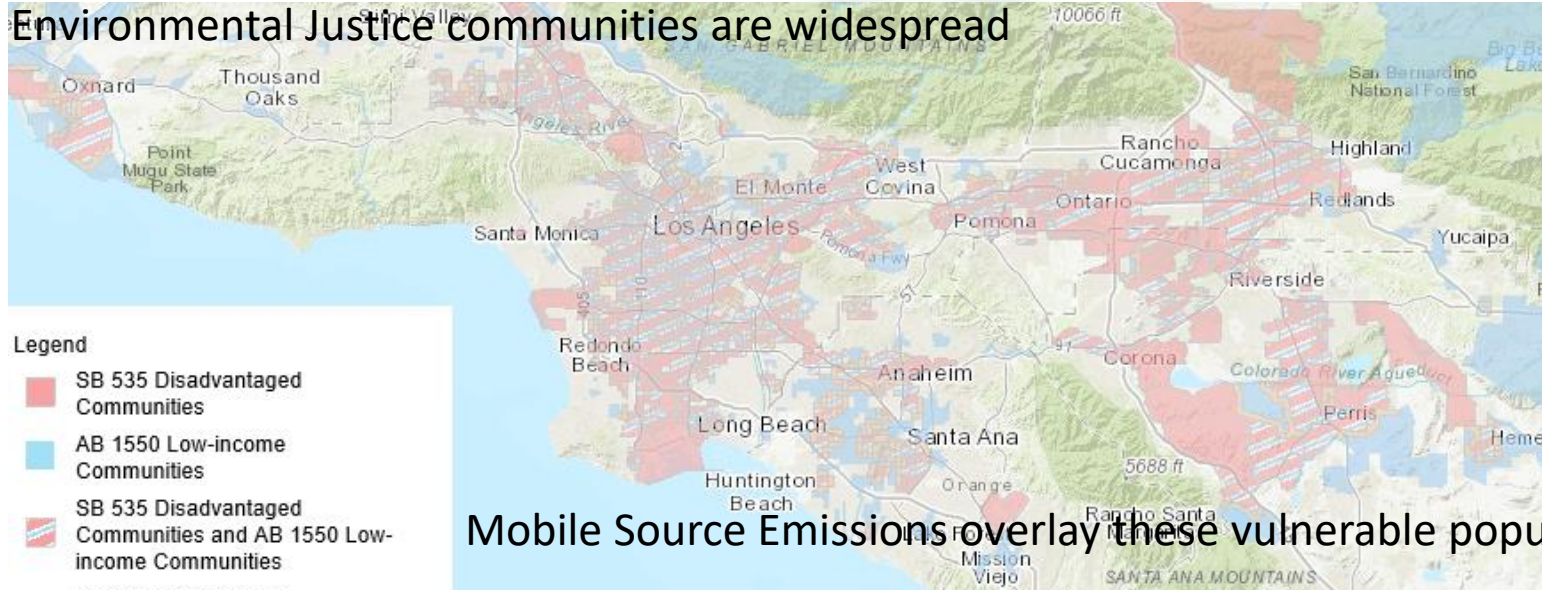
Significant NO_x inventory reductions needed to meet ozone standards in South Coast:

- ~70% reduction by 2023
- ~80% reduction by 2031
- 70ppb Ozone NAAQS attainment coming

NO_x an important to PM in the San Joaquin Valley

Remaining Issues Overlay Critical Areas

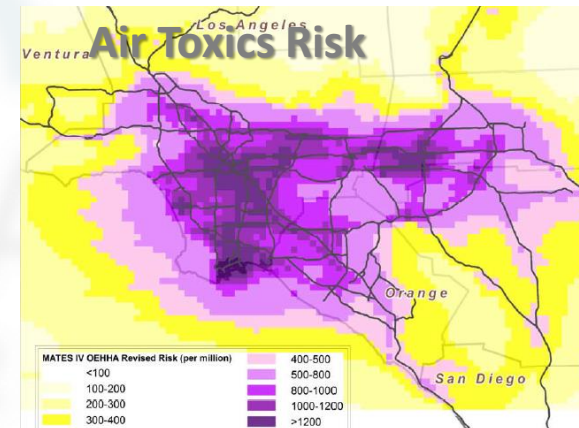
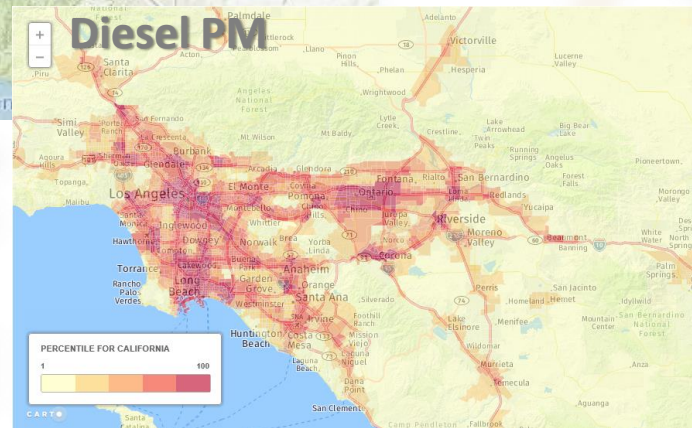
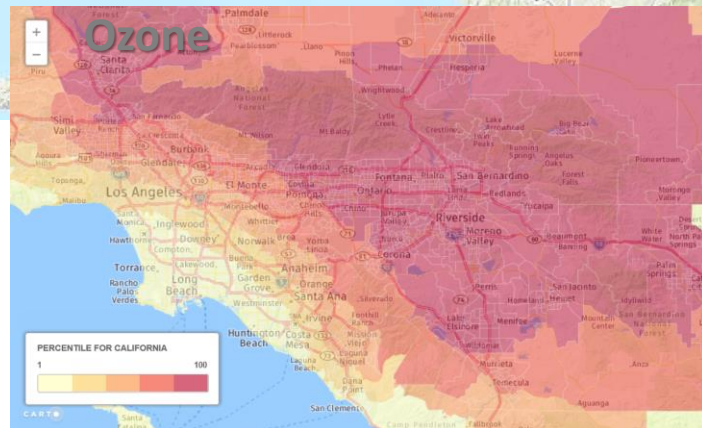
Environmental Justice communities are widespread



- Legend**
- SB 535 Disadvantaged Communities
 - AB 1550 Low-income Communities
 - SB 535 Disadvantaged Communities and AB 1550 Low-income Communities
 - AB 1550 Low-income Communities within a 1/2 mile of a SB 535 Disadvantaged Community

SB210 localizing a focus on “Community Air Protection”

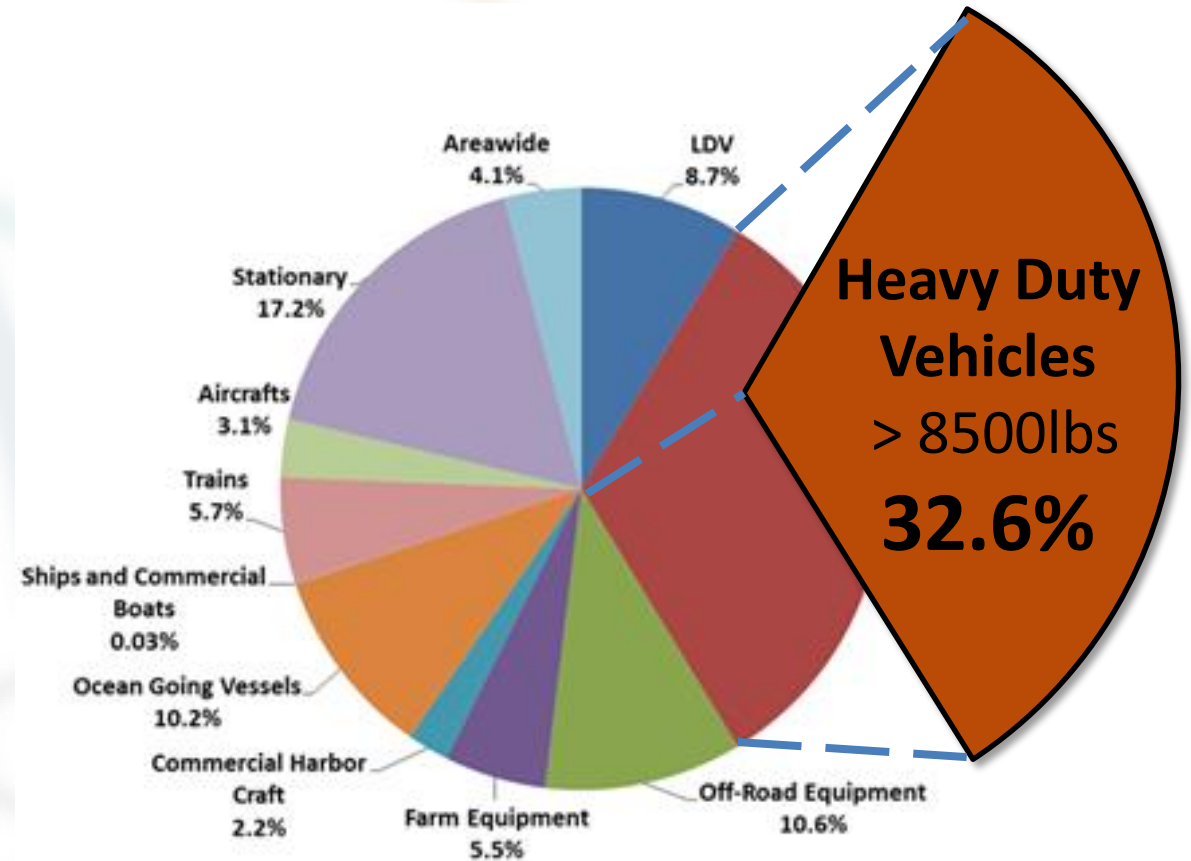
Mobile Source Emissions overlay these vulnerable populations



What is it coming from?

Emissions Inventories: NOx example

- Combustions sources
- Vast majority related to transportation “Mobile Sources”
- Heavy Duty Diesel Trucks emit a disproportionate fraction of CA’s economy wide NOx inventory
- HD Diesel is Largest NOx tonnage SIP commitment in CARB’s 2016 Mobile Source Strategy



NOx during today's 0.2g SCR Phase-in

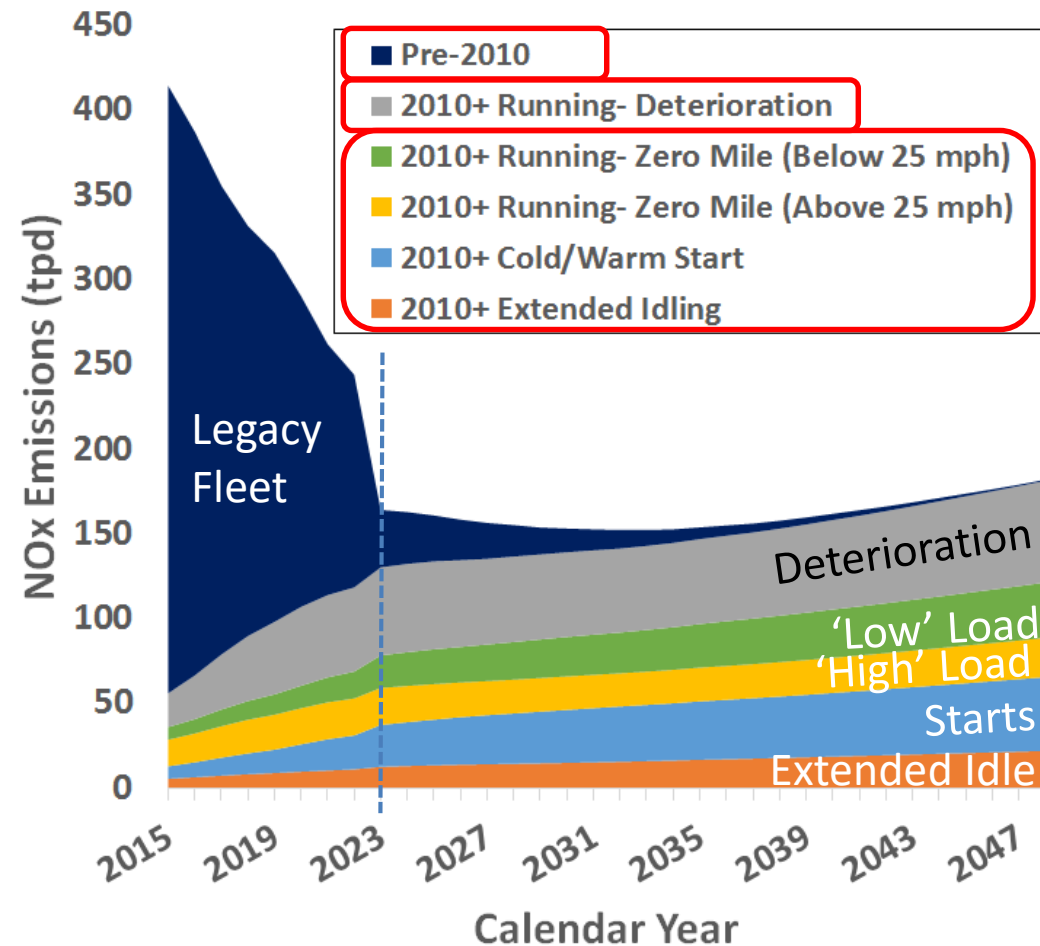
'til 2023 in CA:

- Older Non-SCR trucks dominate NOx
→ Truck & Bus fleet rule drives turnover to the cleaner SCR technology

Beyond 2023:

- Further reductions needed from SCR-equipped truck population
- Economic and population growth reverse NOx trend without further efforts
- Multi-pronged holistic approach required to further reduce SCR-equipped NOx emissions

Heavy Duty Diesel NOx Emissions

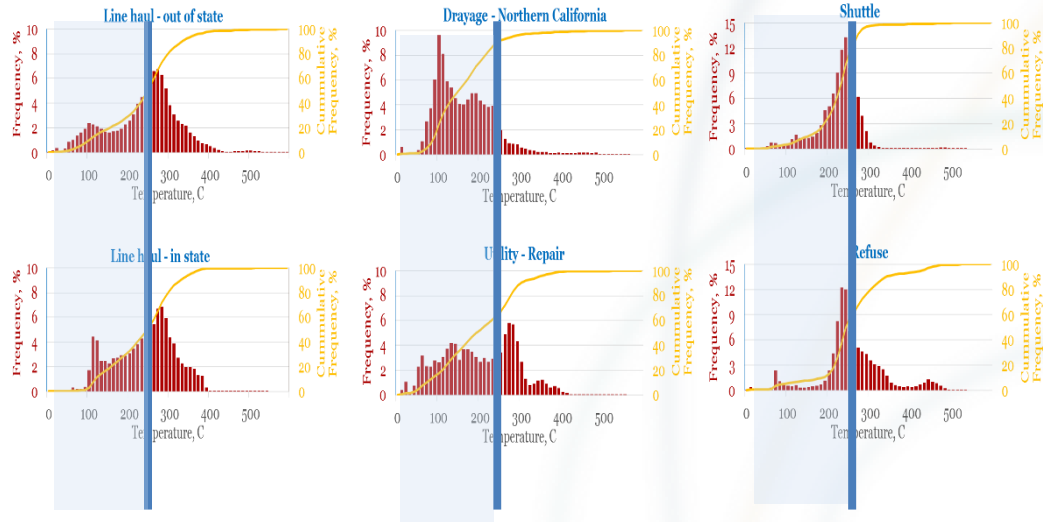


Types of Motivating Data

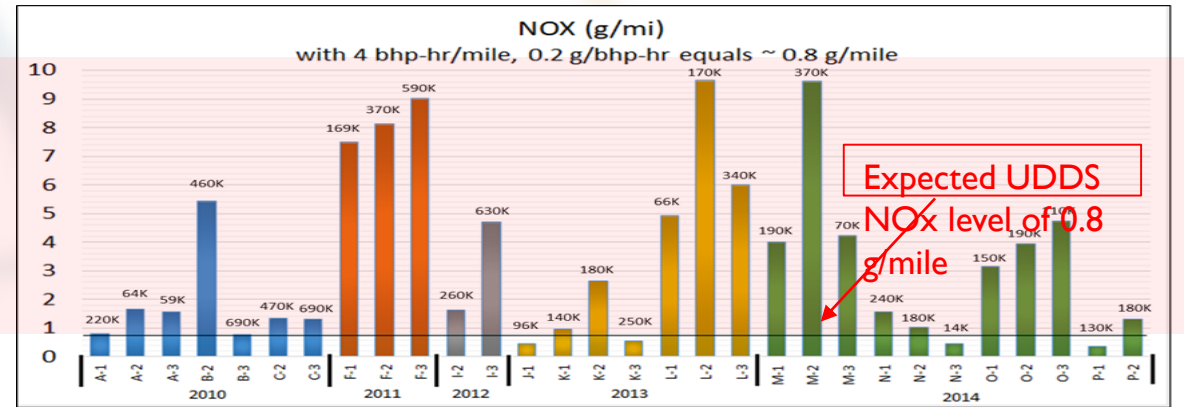
- Calibration/Dutycycle Incompatibilities: cold SCRs ubiquitous, Regen issues for at low load applications
- NOx rates above cert expectations
 - CARB Surveillance chassis lab and PEMS data
 - NOx sensor month-long datalogs
 - Remote sensing/plume capture snapshots
- In-use Compliance: HDIUT ineffective, CARB HDIUC netted recalls
- Warranty Rates initially high but improving, still specific issues
- Optional Low NOx engines from 6L to 12L with broad NOx control

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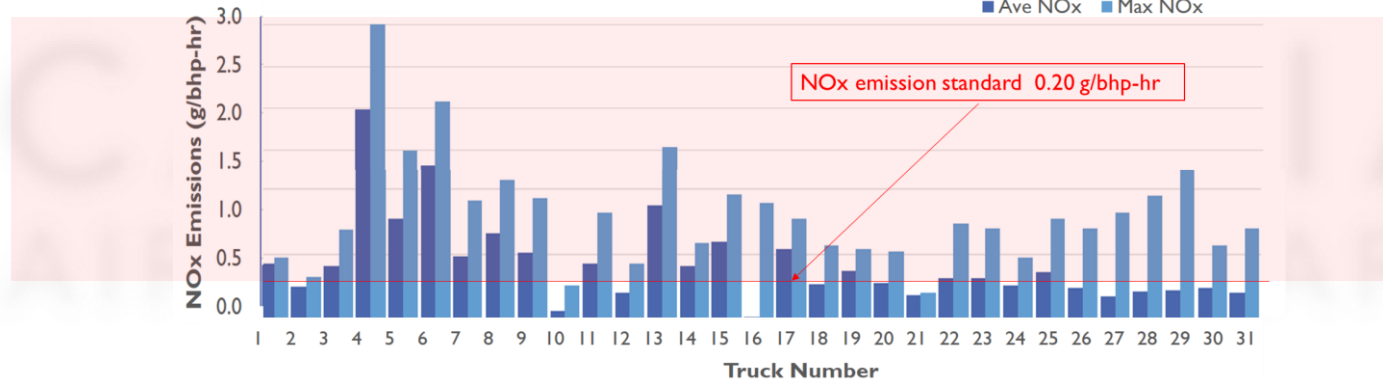
Calibration/Dutycycle incompatibility:
Cold Operation common in datalogs



High NOx: Surveillance Chassis UDDS Tests



High NOx: PEMS NTE Tests



Technology Demonstration Work

- 0.02g NOx gaseous fuel engine demo'ed and commercial since 2016
- 0.02g Diesel targeted work on two platforms underway.
~0.025g NOx FTP seen, further development ongoing.
- Low Load calibration work promising. Assessing 'stock' engine configurations & GHG engine modifications for better NOx
- NREL/SwRI datamining 'representative' Low Load Cycle challenges
- Long range: Low NOx + 15% GHG reduction demo with opposed piston technology. On road with Walmart/Tyson fleets early 2020

Technology Demonstration Work

Exploring

- Engine calibration and heat addition
 - Light off strategies
 - Keep warm strategies
 - Reduced engine NOx at critical times
- Improved catalyst coatings
- Lower temperature DEF dosing approaches
- Thermal mass and order of masses in aftertreatment system:
Early SCR brick and 2nd DEF doser, SCR on Filter, Passive NOx Adsorber options
- NOx & GHG combined technologies managing airflow/exhaust Temp:
cooler and turbine bypasses and Cylinder Deactivation (CDA) options
- Seeking GHG neutral or better packages with cost effective pricing

Omnibus Rulemaking Main Thrusts

- Significantly Lower the NOx standard: “0.0X g/bhphr”
- Require Low Load NOx control (including via Low Load Cycle)
- Adopt an In-Use Compliance metric spanning actual usage dutycycles (similar to Euro moving average window method)
- Increase Warranty and Useful Life definitions to reflect usage
- Improve initial Durability Demonstration procedures

Timeline

- **2013:** Initial demos launch Low NOx Engine/Aftertreatment
- **2016:** First HD Low NOx public workshop
- **2017/18:** Topic specific workgroups, early actions on HD vehicle inspection requirements and warranty (100k→350kmi HHDD)
- **2019 Jan:** Omnibus Rulemaking workshop with following wrkgrps
- **Summer 2019:** Diesel Low NOx demo results mature
- **Fall 2019:** Staff Report and Reg Language for Omnibus Rule finalizing for internal review process
- **Q1 2020:** 45-day notice and CARB Board Hearing for Omnibus Rule
- **2024 and 2027** are Phase 2 GHG steps—seeking to align NOx program

Issues

- CARB welcomes recent US-EPA announcement of the “Cleaner Trucks Initiative”
- CA timeline for adoption and implementation necessarily sooner (2023/4) than US-EPA constraints (2026/7)
- Unit costs tied to production volumes, single technology advantages
- EMA has offered a 0.15g-based voluntary nationwide interim program for 2024. Today’s engines either already cert there or likely could with minor tweaks.
(lower diesel certs today already in 0.06-0.08g range)

Further Information

- Mobile Source Strategy
<https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.htm>
- HD Omnibus Workshop and Workgroup presentations
<https://www.arb.ca.gov/msprog/hdlownox/hdlownox.htm>
- Low NOx Demonstration Stage 1 work summary
<https://ww3.arb.ca.gov/research/veh-emissions/low-nox/low-nox.htm>
- Sponsored HD emissions Research Seminars, (project info, slides & video)
<https://ww3.arb.ca.gov/research/seminars/seminars.htm>
Durbin, Boriboonsomsin, Sharp, Bishop, Kirchstetter, Harley, etc.

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