

June 15, 2017

California Air Resources Board Research Seminar

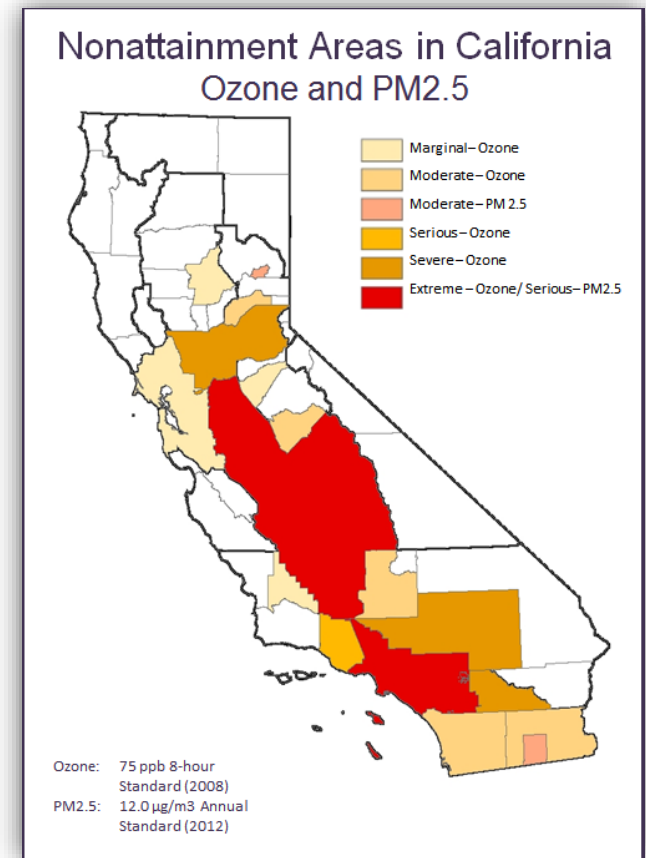
Evaluating Technologies and Methods to Lower Nitrogen Oxide Emissions from Heavy-Duty Vehicles

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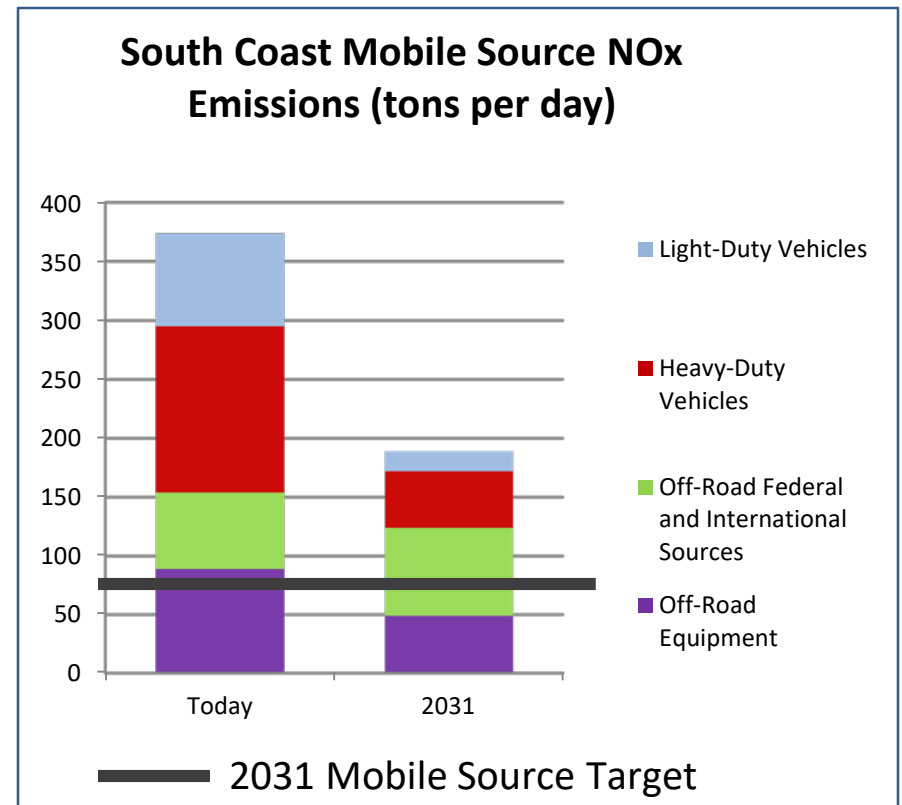
Needs Significant Reduction in NO_x

- California needs significant reduction in NO_x emissions from today's level to meet the NAAQS for PM_{2.5} and ozone by 2031
 - South Coast Air Basin needs 80% NO_x reduction
 - San Joaquin Valley needs 50% NO_x reduction
- Meeting the NAAQS provides significant health benefits
 - Fewer premature deaths, hospital admissions, and emergency room visits



NOx Reductions from Adopted Programs

- Current program NOx benefits by 2031
 - Mobile source emissions reduced >50%
 - Heavy-duty vehicle emissions reduced by nearly 70%
- Heavy-Duty Truck NOx reductions needed beyond turnover to 2010 SCR technology



Regulatory Development Schedule

Hearing	Action	Intent
Adopted	Optional Low NOx Standards (50%, 75% & 90% lower)	Early Deployment
	Innovative Technology Regulation	Certification Flexibilities Hybrids, Low NOx, High Effic. Engines
2017	Smoke Opacity Updates	HD I/M initial steps
	Warranty Period	Beyond 100k mi
	CA Heavy Duty Phase 2 GHG alignment	CA tracking, extra credits & enforcement
2019	Low NOx Engine Performance Requirements	Toward technically achievable control
	Low Load Certification Requirements	Broader duty cycle calibration coverage
	In-Use Compliance Program (what is currently NTE)	Broader duty cycle applicability
	Durability/Useful Life Period Definitions, Warranty Definitions	Rationalize to actual vehicle usage
2020	HD Inspection/Maintenance Program	State of Good Repair level playing field

Current Research for Comprehensively Improving NO_x Performance

Vehicle Activity by Vocation

Semi Tractor Trailers,
Vocational Trucks,
HD Hybrids

In-Use Emissions

Plume Capture, Roadside
Pullover, PEMS & Lab
Surveillance Testing

High Emitter Remedies

Repair Durability,
HD I/M Pilot

Strategy Evaluations

Near Zero pathways for HD,
Low Load metrics & requirements,
I/M methods & structure
GHG credits/VSLs

Technology Demonstrations

ZEV/near-ZEV Pilots & Incentive Funding,
[Low NO_x Engines](#)

Research on Low NO_x Engines

- Evaluating Technologies and Methods to Lower Nitrogen Oxide Emissions from Heavy-Duty Vehicles
 - Explore and demonstrate the feasibility of significant NO_x reduction through engine and aftertreatment control strategies; target the emission rate of 0.02 g/bhp-hr NO_x
 - CARB Funding: \$1.6M
 - Contractor: SwRI
 - Additional support: MECA, Volvo, SwRI
 - Completed and presented today
- Low Load Cycle (LLC) Development and Extension of Low NO_x Calibration to Vocational Operation
 - Develop LLC profiles from vehicle data and develop low load calibrations/approaches for the engine used for the technology evaluation project
 - CARB funding: 1.05M
 - Contractors: SwRI and NREL
 - Additional support: MECA
- Low NO_x Demonstration on an Alternative Non- Turbocompound (TC) Engine
 - Funding: CARB, AQMD, and others (total of \$1.3M)

Low NOX Study Advisory Group

- Participate as technical experts and interested stakeholders
 - EMA, MECA, USEPA, DOE, CEC, and SCAQMD
- Receive periodic status update
- Provide general guidance for the optimum and achievable technology paths
- Provide technical feedback and suggestions during the course of the research
- Express the interests and concerns of their organizations

For More Information

- Low NO_x Project Portal

<https://www.arb.ca.gov/research/veh-emissions/low-nox/low-nox.htm>

- Heavy-Duty Vehicle Rulemaking Portal

Workgroups: https://www.arb.ca.gov/msprog/hdlownox/files/workgroup_description.pdf

Low NO_x: <https://www.arb.ca.gov/msprog/hdlownox/hdlownox.htm>

Phase 2 GHG: <https://www.arb.ca.gov/msprog/onroad/caphase2ghg/caphase2ghg.htm>

Opacity & HD I/M: <https://www.arb.ca.gov/msprog/hdim/hdim.htm>