Journey to Lower NOx Limits through EPA's Cleaner Trucks Initiative

12th Integer Emissions Summit – USA 2019

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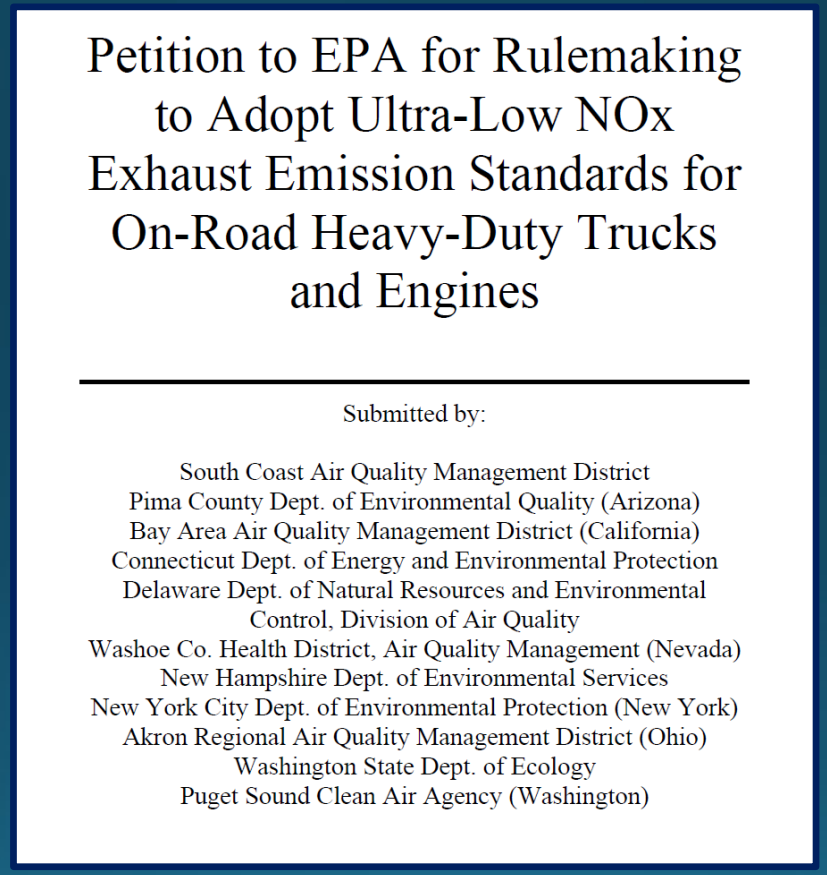
Cleaner Trucks Initiative: Overview

- EPA Motivation
- Analysis of Current & Future NOx Emissions
- Cleaner Trucks Initiative & Key Program Elements
- Current EPA Activities
- Rulemaking Timeframe

EPA Motivation

State & Local Air Quality Agencies Petition EPA

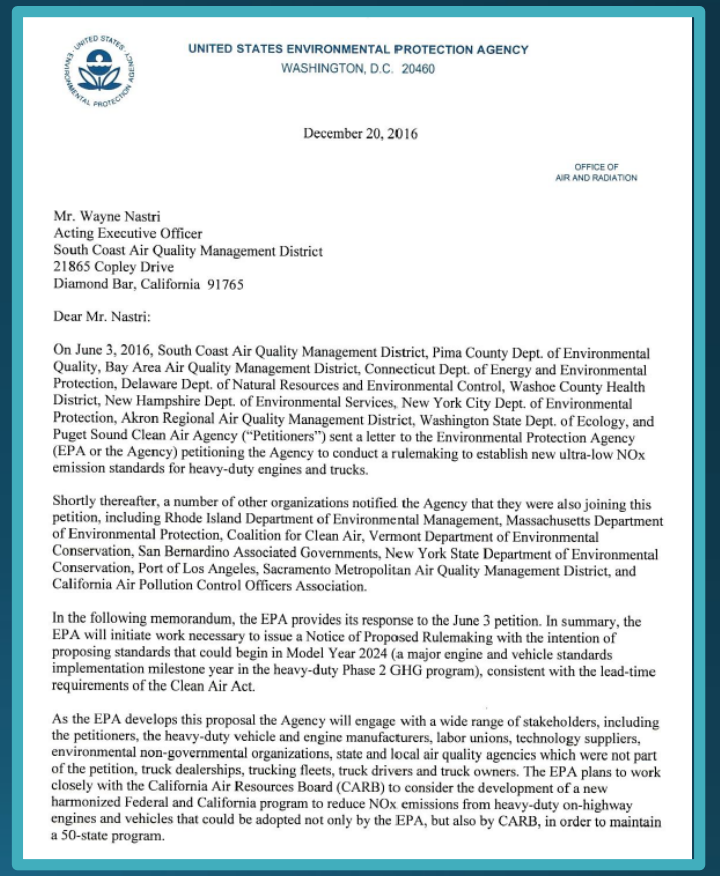
- June 2016: ~20 air quality agencies petition EPA to undertake a new HD NOx rule
- Many HD vehicles travel interstate, and areas impacted most by NOx emissions are distributed around the country
- December 2016: EPA responds to petition—
  - Acknowledge the need for additional NOx reductions
  - EPA will initiate technical work that could be used to support a future action



Petition to EPA for Rulemaking to Adopt Ultra-Low NOx Exhaust Emission Standards for On-Road Heavy-Duty Trucks and Engines

Submitted by:

South Coast Air Quality Management District
Pima County Dept. of Environmental Quality (Arizona)
Bay Area Air Quality Management District (California)
Connecticut Dept. of Energy and Environmental Protection
Delaware Dept. of Natural Resources and Environmental Control, Division of Air Quality
Washoe Co. Health District, Air Quality Management (Nevada)
New Hampshire Dept. of Environmental Services
New York City Dept. of Environmental Protection (New York)
Akron Regional Air Quality Management District (Ohio)
Washington State Dept. of Ecology
Puget Sound Clean Air Agency (Washington)



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

December 20, 2016

OFFICE OF
AIR AND RADIATION

Mr. Wayne Nastri
Acting Executive Officer
South Coast Air Quality Management District
21865 Copley Drive
Diamond Bar, California 91765

Dear Mr. Nastri:

On June 3, 2016, South Coast Air Quality Management District, Pima County Dept. of Environmental Quality, Bay Area Air Quality Management District, Connecticut Dept. of Energy and Environmental Protection, Delaware Dept. of Natural Resources and Environmental Control, Washoe County Health District, New Hampshire Dept. of Environmental Services, New York City Dept. of Environmental Protection, Akron Regional Air Quality Management District, Washington State Dept. of Ecology, and Puget Sound Clean Air Agency ("Petitioners") sent a letter to the Environmental Protection Agency (EPA or the Agency) petitioning the Agency to conduct a rulemaking to establish new ultra-low NOx emission standards for heavy-duty engines and trucks.

Shortly thereafter, a number of other organizations notified the Agency that they were also joining this petition, including Rhode Island Department of Environmental Management, Massachusetts Department of Environmental Protection, Coalition for Clean Air, Vermont Department of Environmental Conservation, San Bernardino Associated Governments, New York State Department of Environmental Conservation, Port of Los Angeles, Sacramento Metropolitan Air Quality Management District, and California Air Pollution Control Officers Association.

In the following memorandum, the EPA provides its response to the June 3 petition. In summary, the EPA will initiate work necessary to issue a Notice of Proposed Rulemaking with the intention of proposing standards that could begin in Model Year 2024 (a major engine and vehicle standards implementation milestone year in the heavy-duty Phase 2 GHG program), consistent with the lead-time requirements of the Clean Air Act.

As the EPA develops this proposal the Agency will engage with a wide range of stakeholders, including the petitioners, the heavy-duty vehicle and engine manufacturers, labor unions, technology suppliers, environmental non-governmental organizations, state and local air quality agencies which were not part of the petition, truck dealerships, trucking fleets, truck drivers and truck owners. The EPA plans to work closely with the California Air Resources Board (CARB) to consider the development of a new harmonized Federal and California program to reduce NOx emissions from heavy-duty on-highway engines and vehicles that could be adopted not only by the EPA, but also by CARB, in order to maintain a 50-state program.

Clean Air Act – Section 202(a) provides specific direction to EPA for Highway Heavy-duty Engines & Vehicles

- Set standards for air pollutants & revise from time to time, must provide 3 years of stability between standards
- Implement after lead-time necessary to develop and apply technology, must provide at least 4 years
- Standards applicable for the engine/vehicle useful life
- Give appropriate consideration to the cost of compliance
- Emission standards for HC, CO, NOx, PM must reflect the greatest degree of emission reduction achievable through technology – considering lead time, cost, energy, & safety

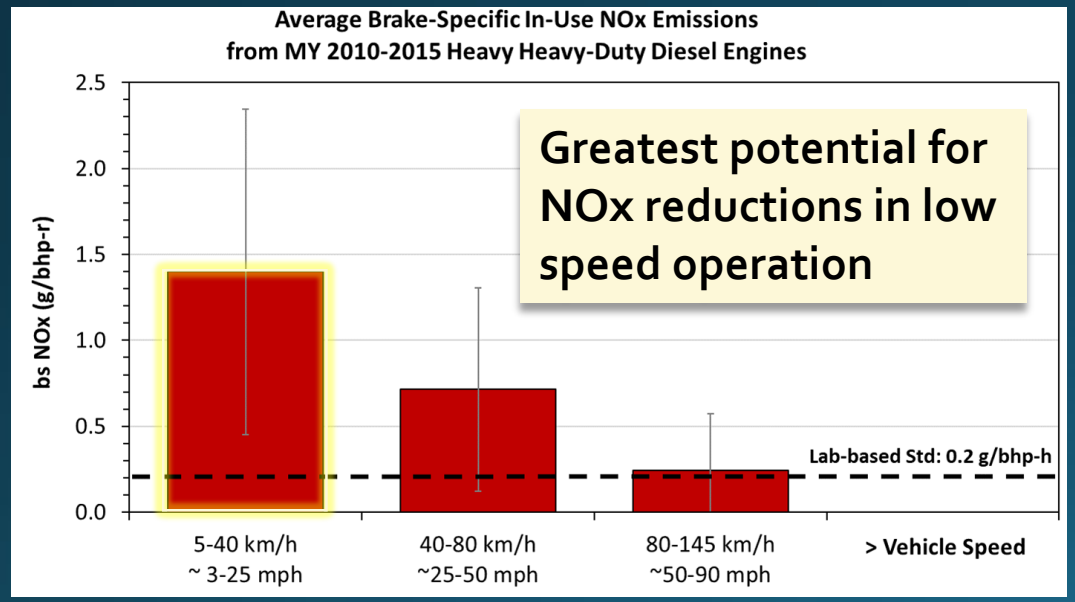
Other Factors:

- EPA last revised NOx standards for heavy-duty trucks nearly 20 years ago
- We have an opportunity to modernize the requirements to better reflect the capability of available emissions control technologies
- EPA current emissions standards have lowered *overall* NOx emissions, but have not resulted in effective emission control under low-load conditions (e.g. when trucks are at idle, moving slowly, or in stop-and-go traffic)
  - By addressing low-load operation, we can improve NOx emission controls in cities and in areas of high traffic, making a big difference to communities

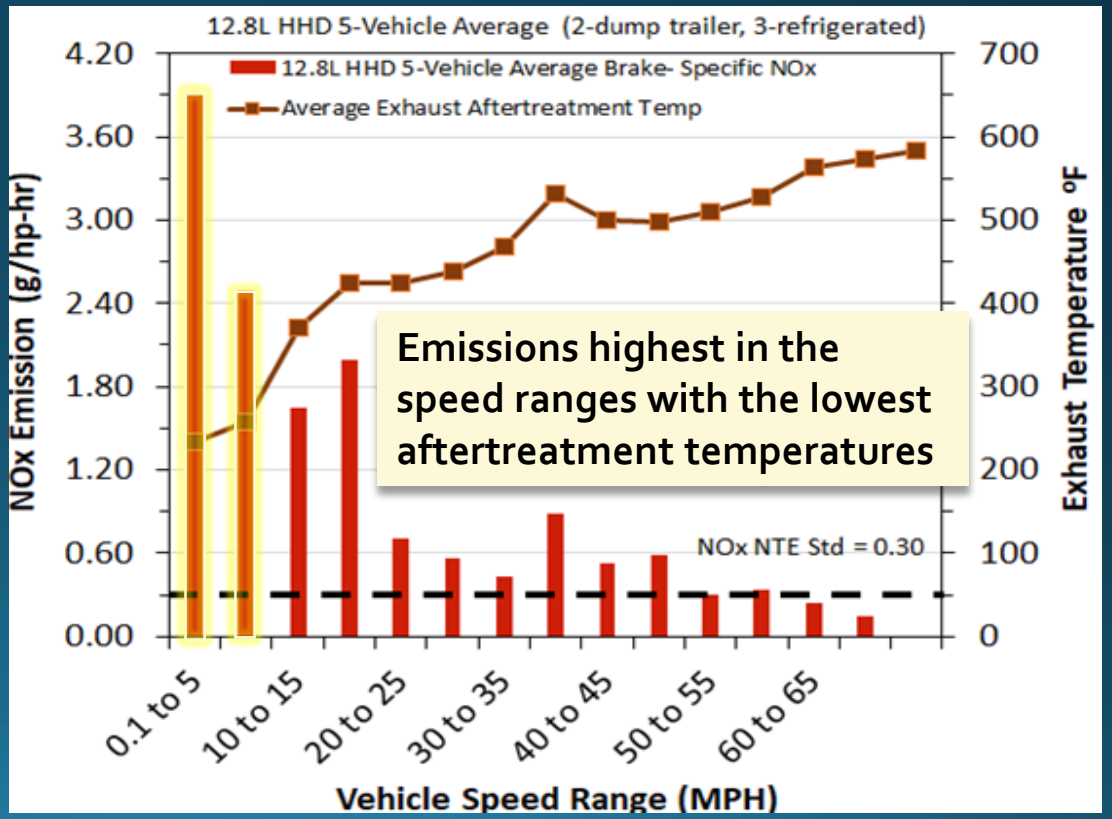
Analysis of Current & Future NOx Emissions

Where do we see higher NOx emissions on the road? *During Low Load Operation*

Data from 93 vehicles; all engines certified to 0.2 g/bhp-h in pre-production lab tests



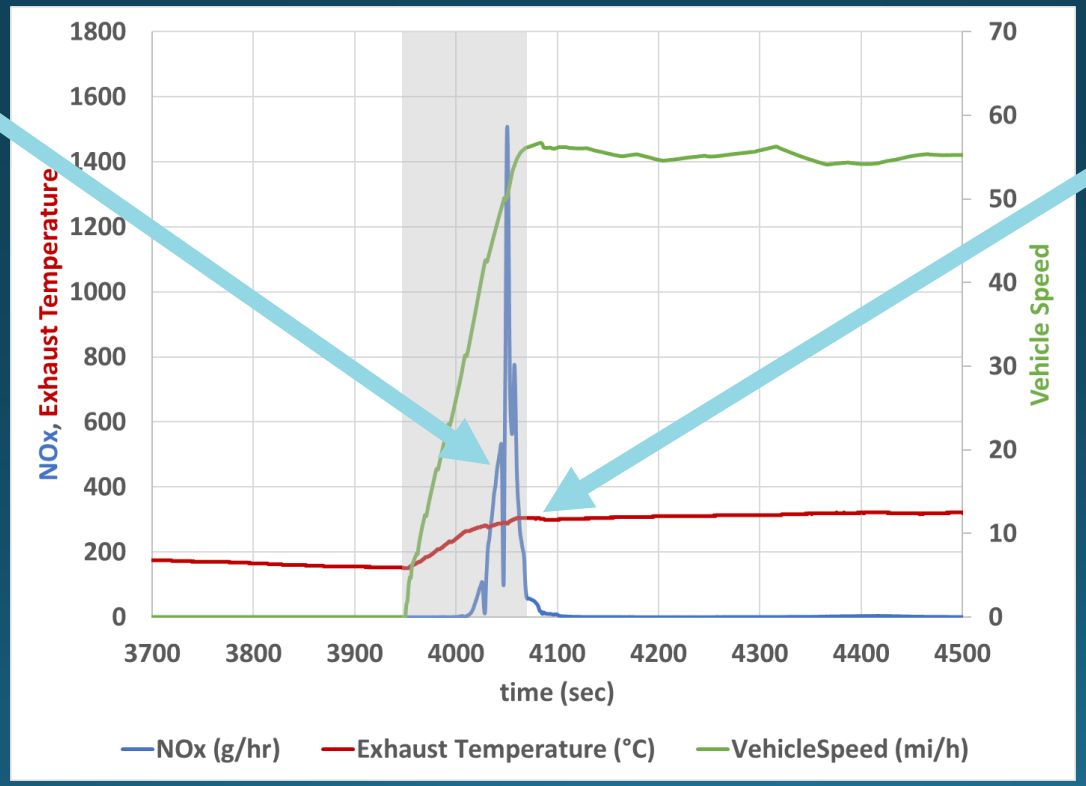
Data from 5 vehicles; all engines passed in-use testing standard of 0.3 g/bhp-h for conditions outlined in the test procedure



Air Quality & Emissions—Chassis Testing for Deeper Understanding

2018 Freightliner Cascadia equipped with a Detroit Diesel 15l engine

Some elevated NOx emissions occur during transition from low-load to high-load

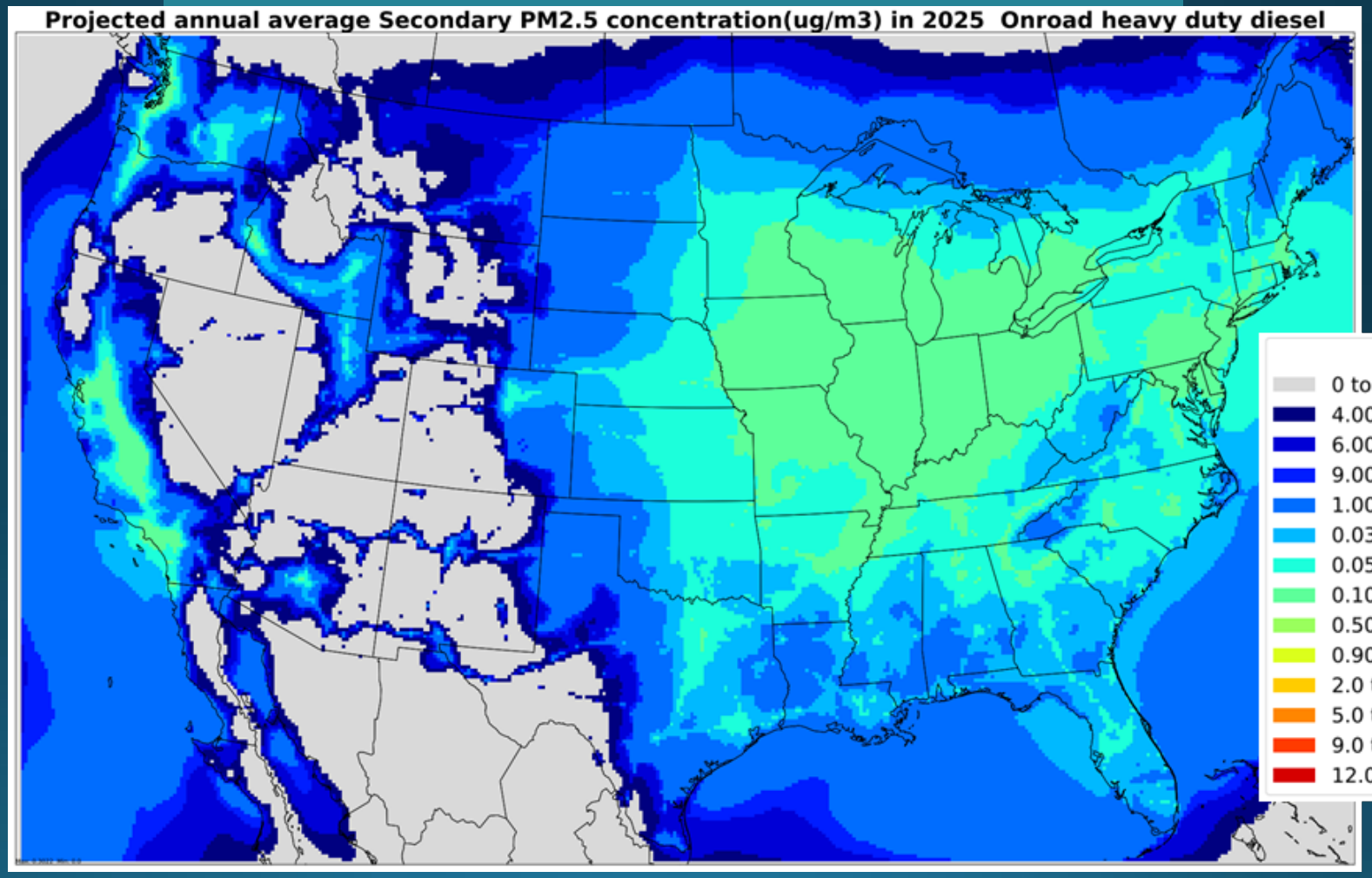


Keep aftertreatment hot in all conditions to reduce emissions breakthrough

Impact of NOx Emissions from Heavy-Duty Diesel Vehicles

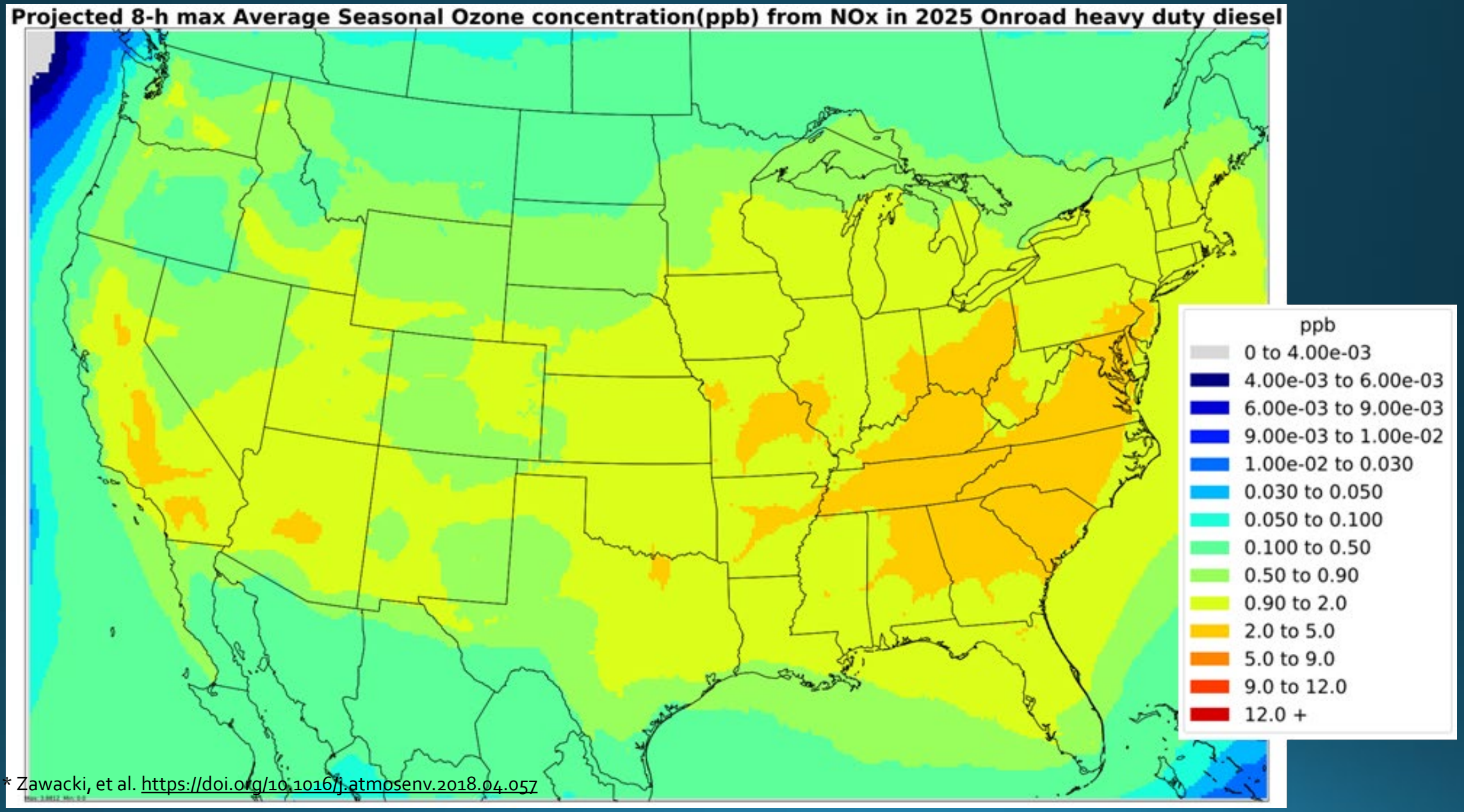
- Large contributor to mobile source NOx
- One of the largest mobile source contributors to ozone in 2025
- Significant mobile source contributor to PM2.5 in 2025, due to
  - NOx emissions which form PM & Directly emitted PM

HDD NOx Contribution to Ambient PM2.5 in 2025



* Zawacki, et al. https://doi.org/10.1016/j.atmosenv.2018.04.057

Heavy-Duty Diesel NOx Contribution to Ozone in 2025



* Zawacki, et al. https://doi.org/10.1016/j.atmosenv.2018.04.057

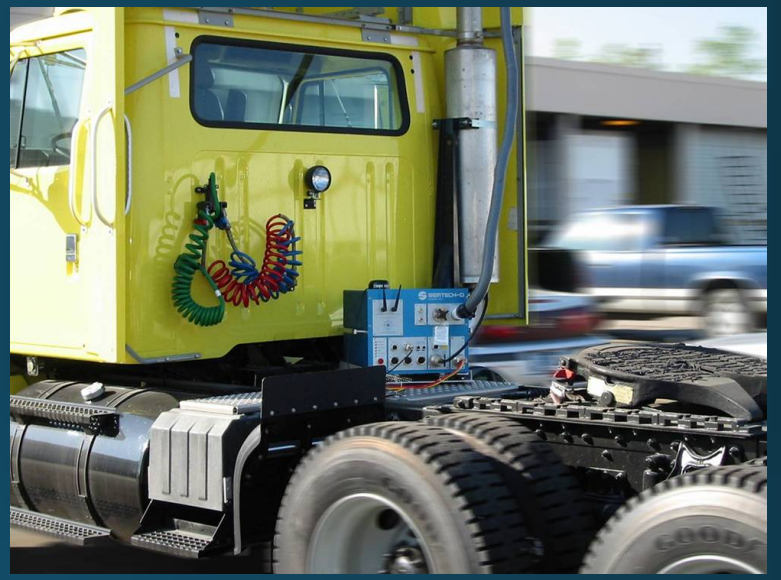
Cleaner Trucks Initiative & Key Program Elements

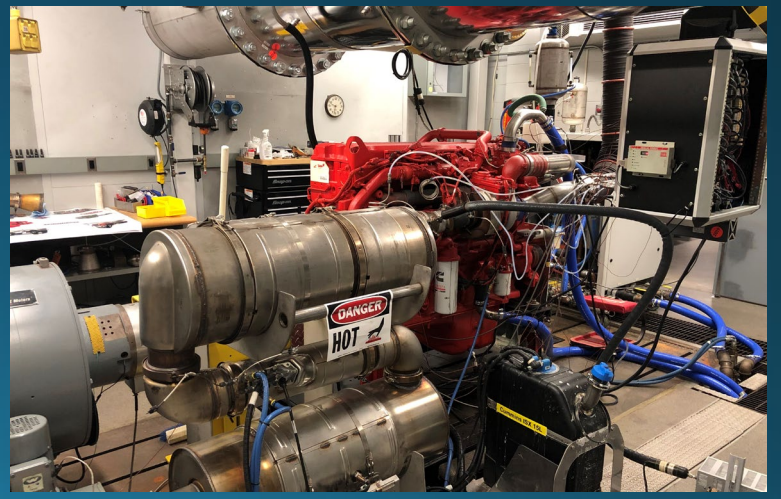
The Cleaner Trucks Initiative

- On November 13, 2018, EPA Administrator Andrew Wheeler announced the "Cleaner Trucks Initiative" (CTI)
- Objective is to achieve lower NOx emissions *nationwide*—
  - Ensure real world emissions reductions
  - Improving certification and in-use testing requirements
  - Pursue a national, harmonized program
  - Focus on NOx, but take a broad look at other heavy-duty engine emissions
- Identify means of ensuring real-world compliance and explore opportunities to streamline existing requirements

Key Program Elements being Explored

- **Nationwide Emissions Reductions**
  - Work to closely align CARB and Federal long-term programs
  - Continue technical coordination with CARB and industry
- **Ensure In-Use Emissions Reductions**
  - New in-use protocol that covers "all" in-use operation
  - Conducting and contributing to multiple technology demonstration programs
  - Regulatory useful life and warranty that reflect current operating life
- **Streamline & Modernize Requirements**
  - Accelerated aging protocol for diesel aftertreatment systems
  - Incentives for advanced technologies: 0 gram NOx
- **Effective EPA Compliance & Enforcement**
  - Utilize onboard data streams to identify emissions compliance concerns early
  - Consider technologies which can discourage tampering with emissions control technologies





Program Elements that Impact Emissions Inventories

Engine Certification (Laboratory-based testing)	**In-Use Requirements** (Real-world testing)
Current 0.2 g/hp-h for highway and city drive cycles	**Current** One standard applies to narrow range of highway-focused operation
Future Reduction for city and highway drive cycles Evaluating CARB's low-load cycle	**Future** Evaluating separate standards for 3 broader ranges of operation: idle, low load, and mid-to-high load

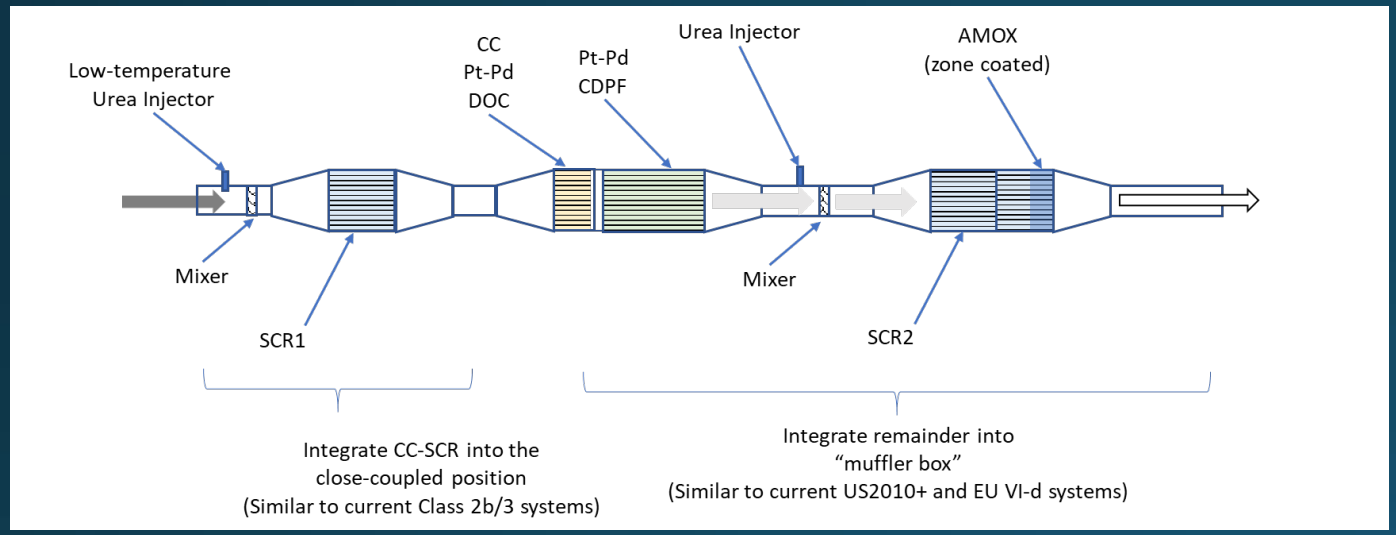
Program Integrity Requirements

- Lengthen useful life
- Lengthen emissions warranty

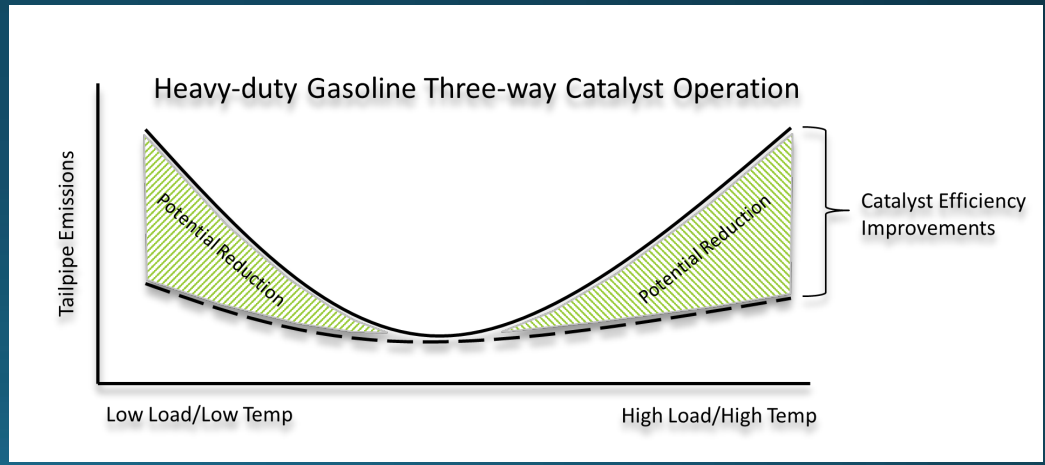
Current EPA Activities

EPA Technology Assessment

Evaluating performance of next generation aftertreatment configurations and formulations



Investigating strategies to improve HD gasoline catalyst performance



Exploring cylinder deactivation to increase diesel exhaust temperatures without raising CO_2 emissions

Cylinder Deactivation (Eaton)

CTI: Ongoing Technical Assessment

(Not Comprehensive)

EPA @ SwRI Southwest Research Institute

- Baseline HDD engine performance over engine dyno test cycles
- HDD cylinder deactivation demonstration
- HD gasoline baseline and advanced technology demonstration

California Air Resources Board

- Advanced technology demonstration (Stage 1-3 HDD engines)
- Low-load cycle development
- NREL cost study

EPA United States Environmental Protection Agency National Vehicle and Fuel Emissions Laboratory

- Evaluate baseline emissions (HDIUT)
- HD gasoline assessment
- Next generation engine and aftertreatment demonstration
- HDV chassis & PEMS testing
- NO_x sensor performance

Truck & Engine Manufacturers Association™

- WVU activity and in-use emissions study
- Possible NO_x sensor performance evaluation at SwRI

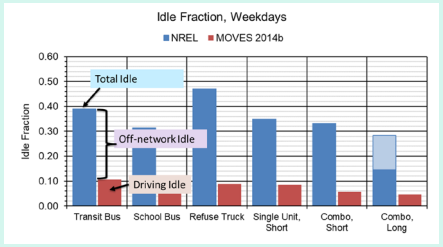
Environment and Climate Change Canada

- HDV chassis & PEMS testing
- NO_x sensor performance

CTI: Additional Ongoing Analyses

New Data On…

HD Activity



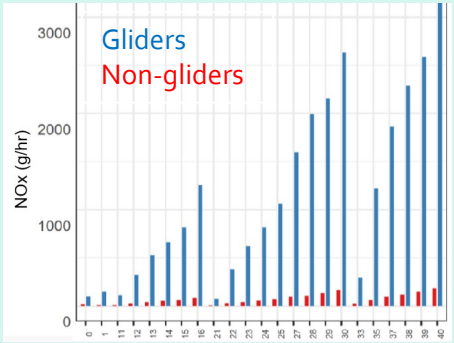
VMT & Vehicle Populations

eia Independent Statistics & Analysis U.S. Energy Information Administration

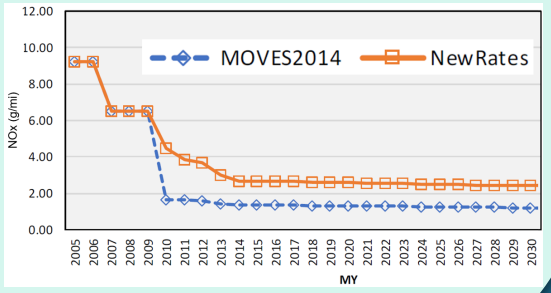
IHS

Federal Transit Administration

Glider Vehicles



HD Emission Rates



MOVES Motor Vehicle Emission Simulator

Updated for CTI*

Developing new data on—

- **Emissions Inventories**
- **Full Air Quality Analysis (CMAQ)**
- **Benefits Calculations (BenMAP)**
- **Proposed Program Benefit-Cost Analysis**

* Will not be a new release of MOVES – an update for the CTI analysis only

CTI: Early EPA Stakeholder Engagement

(Not Comprehensive)

User Community

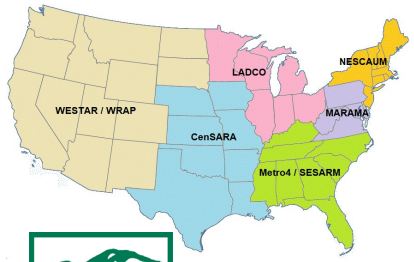
OOIDA — Owner-Operator Independent Drivers Assn.

ATA — American Trucking Associations

NTEA — The Association for the Work Truck Industry

ATD — American Truck Dealers, A Division of NADA

State, Local, Tribal Governments & Air Associations



NTAA — National Tribal Air Association

NACAA — national association of clean air agencies

AAPCA — Association of Air Pollution Control Agencies

CAPCOA — California Air Pollution Control Officers Association

ECOS

South Coast AQMD

California Air Resources Board

Suppliers & Labor

UAW

MECA

Eaton

MEMA

Tenneco

BASF

Johnson Matthey — Inspiring science, enhancing life

Clean Air & Env. NGOs

EDF — Environmental Defense Fund — Finding the ways that work

NRDC — Natural Resources Defense Council

icct — The International Council on Clean Transportation

American Lung Association

Union of Concerned Scientists — Science for a Healthy Planet and Safer World

OEMs

Truck & Engine Manufacturers Association™

PACCAR

Cummins

Hino

GM

Detroit

Daimler

Volvo

Volvo Trucks

Navistar®

Ford

Isuzu

FCA

CTI Rulemaking Timeframe and Status

- Targeting 2020 for a Notice of Proposed Rulemaking
  - Comment period after the proposal, followed by Final Rulemaking

- Currently in the information-gathering stage
  - Early outreach to stakeholders
  - Continuing engagement and coordination with California Air Resources Board (CARB) staff on technical work
  - Assessing technical feasibility—evaluating the effectiveness of advanced technologies and compliance strategies
  - Developing the cost, benefit, emissions inventory, air quality, and economic analyses to inform the CTI proposal

Points of Contact in EPA's Office of Transportation & Air Quality

- CTI Rulemaking Team Leads
  - Christy Parsons, Parsons.Christy@epa.gov, 734-214-4243
  - James Sanchez, Sanchez.James@epa.gov,734-214-4439
  - Jessica Brakora, Brakora.Jessica@epa.gov, 734-214-4936
- Brian Nelson, Director, Assessment & Standards Division's Heavy-Duty Onroad & Nonroad Center, Nelson.Brian@epa.gov, 734-214-4278
- Kathryn Sargeant, Deputy Director, Assessment & Standards Division, Sargeant.Kathryn@epa.gov, 734-214-4441
- Bill Charmley, Director, Assessment & Standards Division, Charmley.William@epa.gov, 734-214-4466