EPA's Cleaner Trucks Initiative

ERC 2019 Symposium

June 5, 2019

James Sanchez

Office of Transportation & Air Quality, US EPA

Overview

- Motivation
- Cleaner Trucks Initiative
- Program Elements being Explored
- Current EPA Activities
- Rulemaking Schedule
- Opportunities for Ongoing Engagement

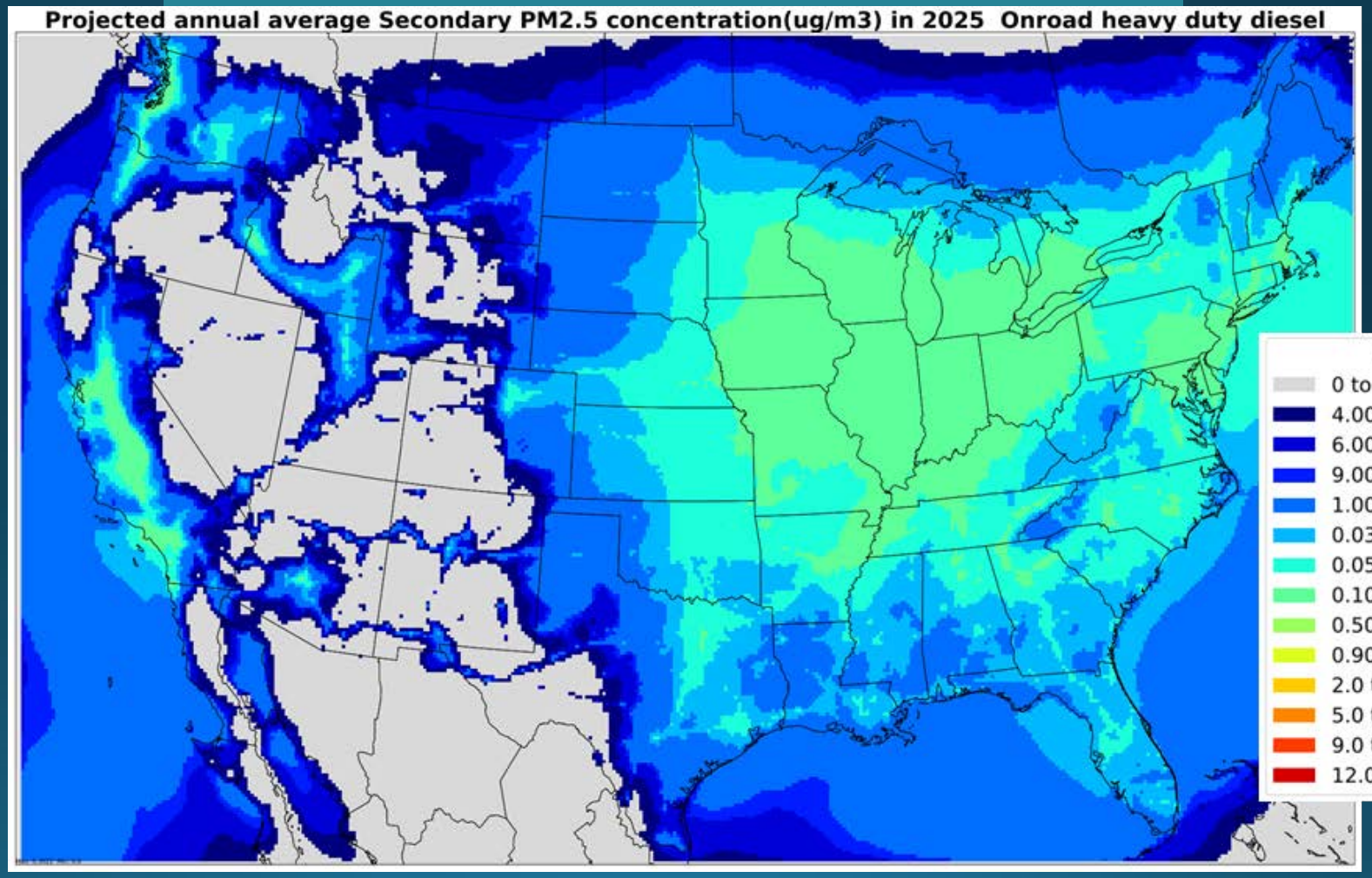
Motivation

- 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 (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

Impact of NOx Emissions from Heavy-Duty Diesel Vehicles

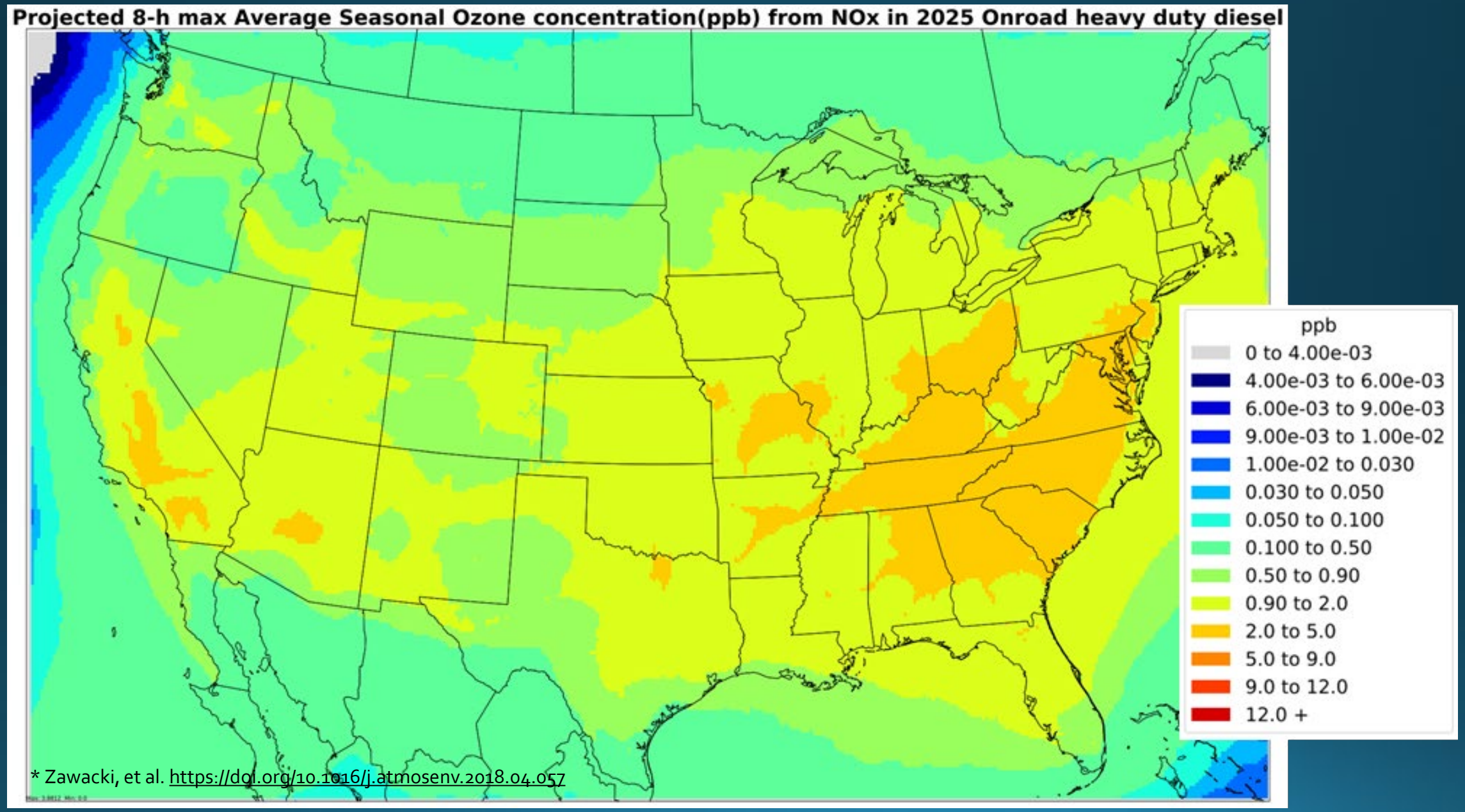
- Large contributor to mobile source NOx
- One of the largest mobile source contributors to ozone in 2025
- Significant mobile source contributor to PM2.5 in 2025, due to
  - NOx emissions which form PM & Directly emitted PM

HDD NOx Contribution to Ambient PM2.5 in 2025



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

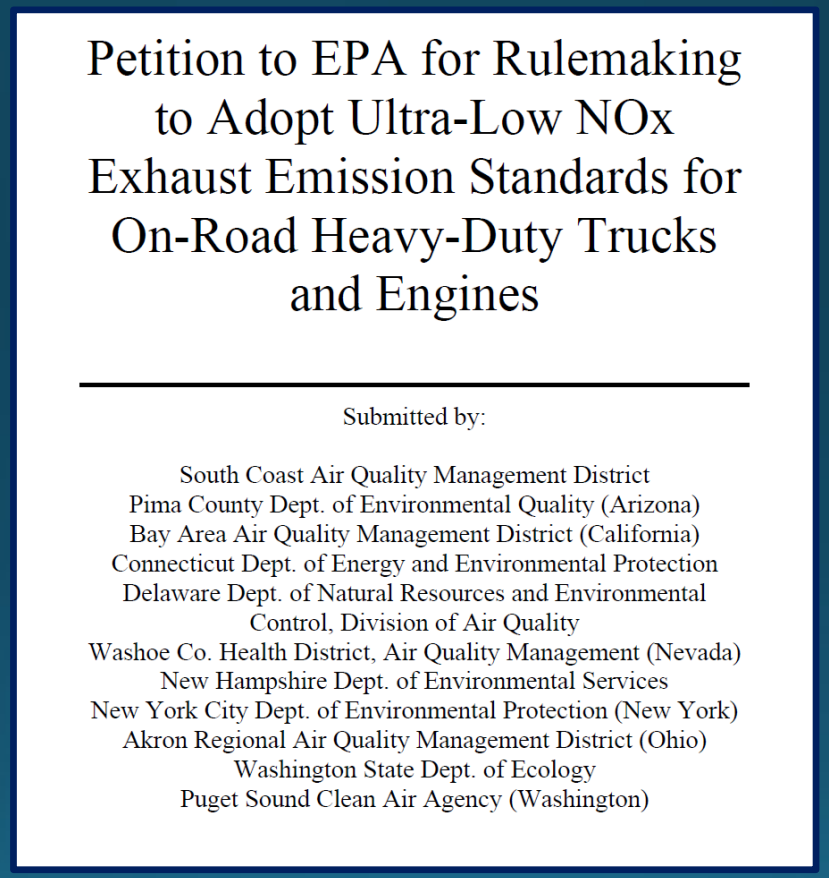
Heavy-Duty Diesel NOx Contribution to Ozone in 2025



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

State & Local Air Quality Agencies June 2016 Petition

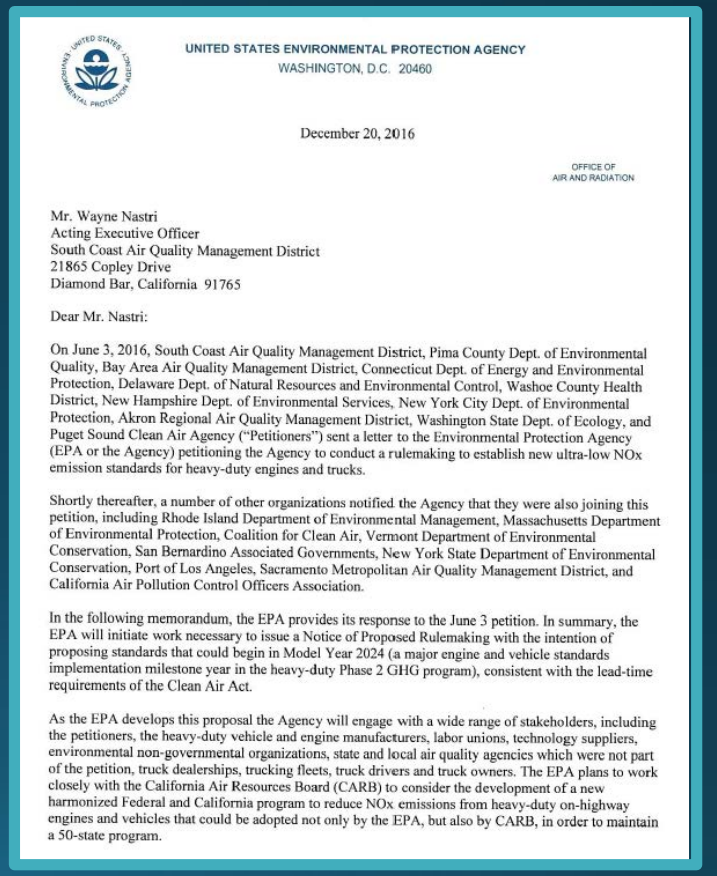
- Many HD vehicles travel interstate, and areas impacted most by NOx emissions are distributed around the country
- June 2016: ~ 20 state and local air quality agencies petitioned EPA to undertake a new HD NOx rule
- December 2016: EPA responded
  - Acknowledge the need for additional NOx reductions
  - 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.

The Cleaner Trucks Initiative

- On November 13, 2018, EPA Administrator Andrew Wheeler announced the "Cleaner Trucks Initiative" (CTI) to address emissions from new heavy-duty trucks and engines

- Our objective is to achieve lower NOx emissions *nationwide*—
  - Ensure real world emissions reductions
  - Investigate options for improving current 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

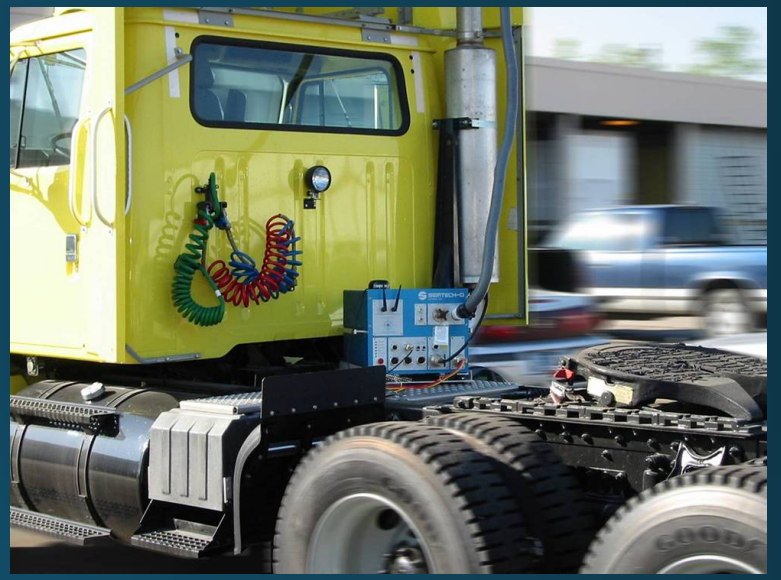
- Identify cost-effective means of ensuring real-world compliance and explore opportunities to streamline existing requirements

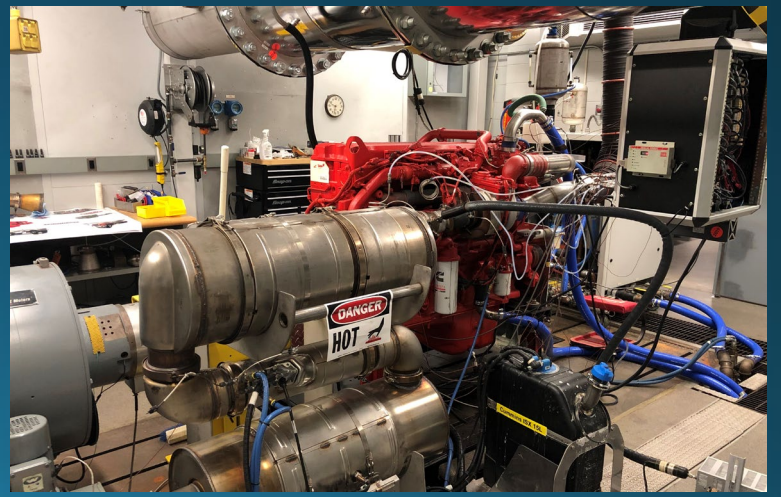
Clean Air Act – Section 202(a) provides specific direction to EPA for Highway Heavy-duty Engines & Vehicles

- 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

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





CTI Rulemaking Timeframe and Current 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 cost, benefit, emissions inventory, air quality, and economic analyses

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

JM 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

cma — Truck & Engine Manufacturers Association™

PACCAR

Cummins

Hino

GM

Detroit

Daimler

Isuzu

Volvo

Volvo Trucks

Navistar®

Ford

FCA

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

Additional Stakeholder Data

- Possible telematic data from a HD truck fleet

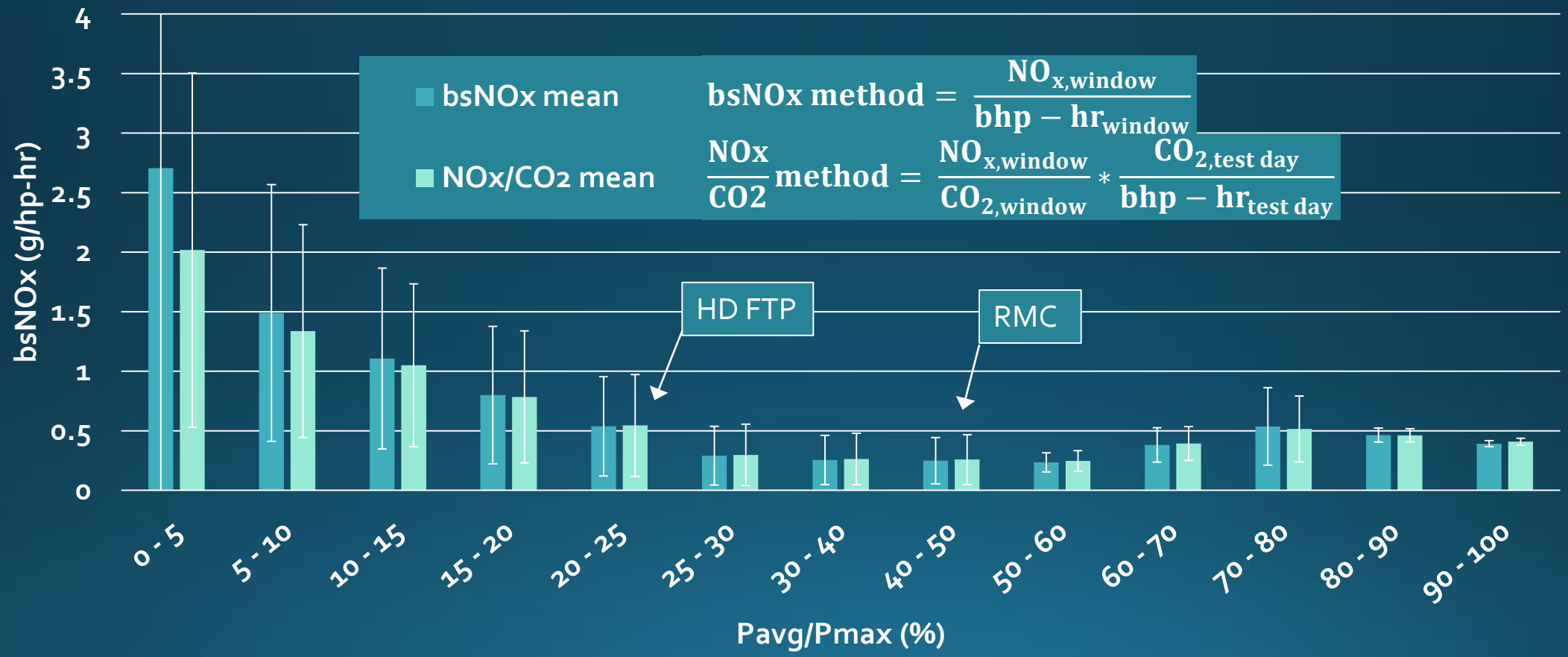
Truck & Engine Manufacturers Association™

- 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

In-use Data

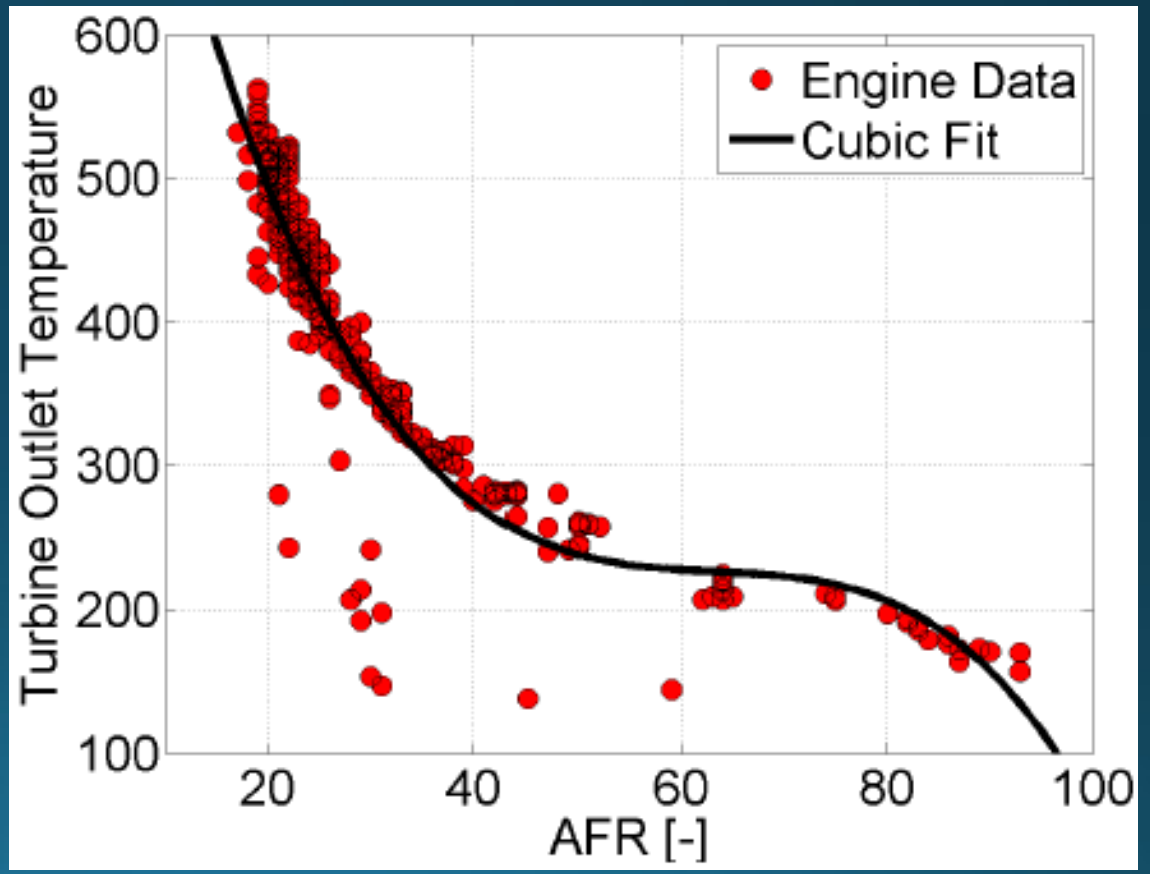


HHD with NOx FEL ≤ 0.20 g/bhp-hr | 85 vehicles, 2.90 million windows
Work-windows are calculated over continuous seconds. Consecutive windows have overlapping seconds. Error bars are SD of the mean.

Methods for Increasing Exhaust Temperature

- Adding additional exhaust energy:
  - Add post-main fuel injection
  - Exhaust fuel burner
  - Electrically heated catalysts
- Reduce air fuel ratio:
  - Throttling
  - Boost reduction (higher loads)
  - Valve events
  - EGR (up to a point- outliers are high EGR points)
  - Cylinder deactivation

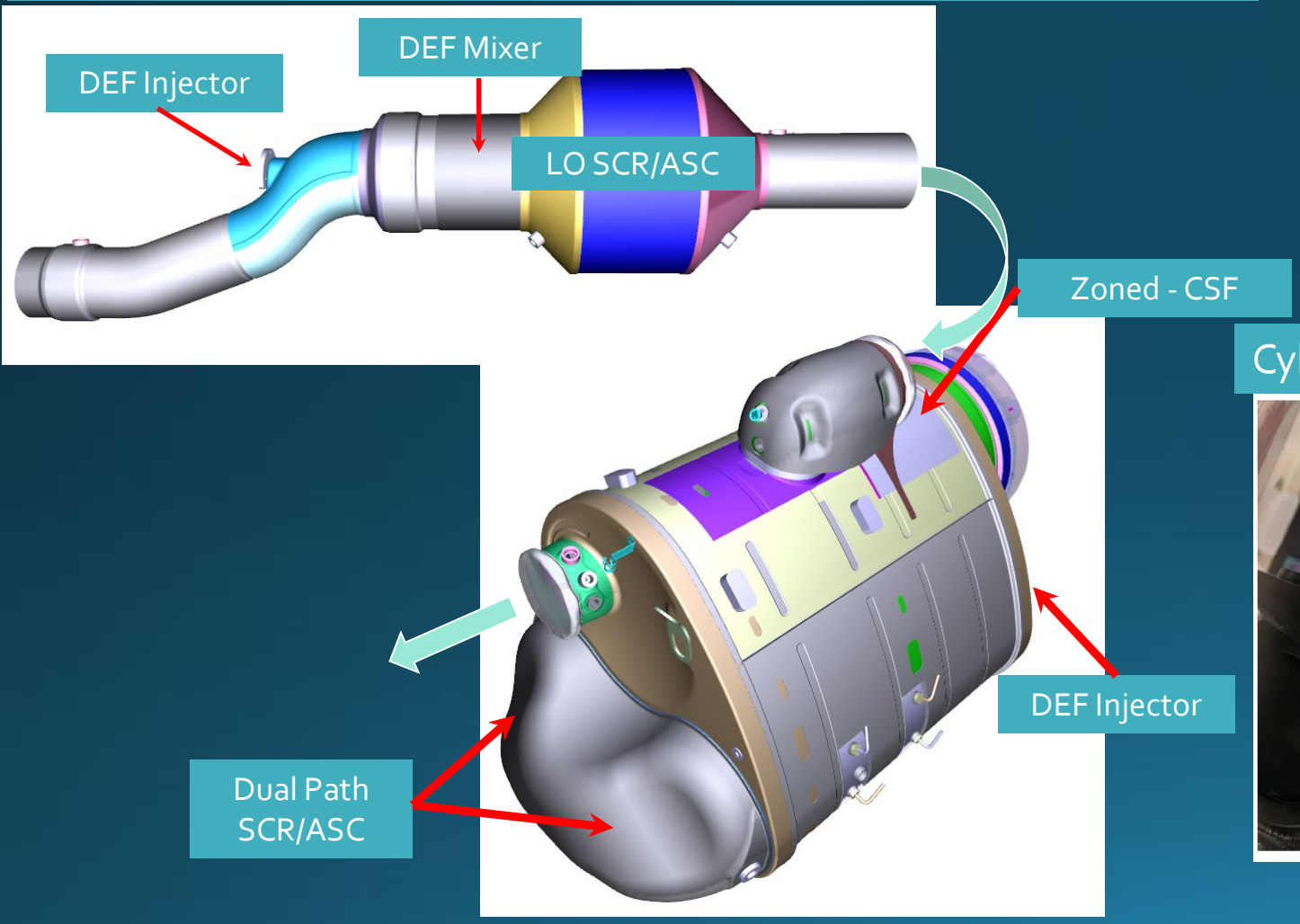
Turbine Out Temperature (°C) vs AFR



2014 Magee, "Exhaust Thermal Management Using Cylinder Deactivation and Late Intake Valve Closing"

Technology Assessment @ EPA National Vehicle and Fuel Emissions Laboratory, Ann Arbor

One of the configurations being considered for EPA demo engine

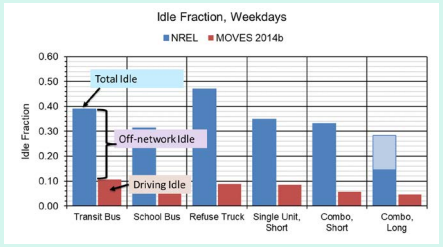


Cylinder-deactivation through Eaton's collapsible lifter

CTI: Major Updates for HD Emissions Projections

New Data On…

HD Activity



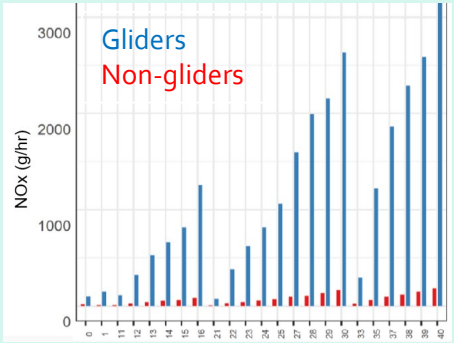
VMT & Vehicle Populations

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

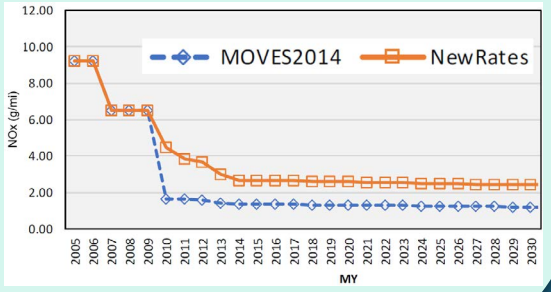
IHS

Federal Transit Administration

Glider Vehicles



HD Emission Rates



MOVES Motor Vehicle Emission Simulator

Updated for NPRM*

NPRM

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 NPRM analysis

Opportunities for Early Engagement

- **Opportunities for communication**
  - Meetings with OTAQ staff to discuss updates on EPA work and share your perspectives related to the rulemaking

- **Information of interest to us**
  - Your perspectives (and analysis where available) on the role of heavy-duty vehicle NOx emissions on air quality, or other environmental challenges
    - The research you are conducting on technologies that can be used to reduce NOx from HD engines
    - Data analysis techniques or sensor technology that could be use to assess in-use emissions and that could be use for in-use compliance requirements

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

  - Bill Charmley, Director, Assessment & Standards Division, Charmley.William@epa.gov, 734-214-4466