OZONE TRANSPORT COMMISSION

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February 20, 2020

Andrew Wheeler, Administrator
U.S. Environmental Protection Agency
Air and Radiation Docket and Information Center
EPA Docket Center, EPA WJC West Building
1301 Constitution Avenue, NW Room 3334
Washington, DC 20004
Attention: ***Docket ID No. EPA-HQ-OAR-2019-0055***

Dear Administrator Wheeler:

The Ozone Transport Commission (OTC) and the Mid-Atlantic/Northeast Visibility Union (MANE-VU) are submitting comments to the U.S. Environmental Protection Agency (EPA) on its Advance Notice of Proposed Rulemaking (ANPR) entitled *Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine Standards* [85 Fed. Reg. 3306-3330 (January 21, 2020)].

In the 1990 Clean Air Act Amendments, Congress established the OTC in order to address regional ozone pollution affecting the OTC member jurisdictions. The OTC members are Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia. In addressing their collective regional ozone problem, the OTC members are responsible for developing and implementing initiatives to reduce nitrogen oxides (NOx) and volatile organic compounds (VOCs), the emitted precursor air pollutants that contribute to the formation of ground-level ozone pollution. MANE-VU was formed to promote haze planning activities for the region by providing a forum for discussion, and encouraging coordinated actions, within and outside of the region. MANE-VU's structure includes a board comprised of state and tribal commissioners/secretaries and air program directors.

The OTC and MANE-VU strongly support EPA's initiative to develop new engine emission standards and test procedures that will reduce NOx emissions from heavy-duty engines. NOx emissions are a primary precursor to the formation of ground-level ozone and secondary fine particulate matter ($PM_{2.5}$) and contribute to acid deposition, eutrophication, and visibility impairment in the Ozone Transport Region (OTR).

Impact of NOx Emissions on Public Health and the Environment

NOx emissions are the major drivers of surface ozone concentrations at the regional scale in the eastern United States. High ozone concentrations compromise the health and welfare of the citizens living in the OTR. Epidemiological studies provide strong evidence that ozone is associated with respiratory effects, including increased asthma attacks, as well as increased hospital admissions and emergency department visits for people suffering from respiratory diseases. Ozone can cause chronic obstructive pulmonary disease (COPD), and long-term exposure may result in permanent lung damage, such as abnormal lung development in children. There is also consistent evidence that short-term exposure to ozone increases risk of death from respiratory causes.[1] Furthermore, recent studies show that ozone concentrations below the current National Ambient Air Quality Standards (NAAQS) continue to contribute to the risk of premature death in sensitive populations, such as the elderly.[2]

Millions of OTR residents live in areas that violate the ozone NAAQS. A large portion of the OTR is designated as in nonattainment with the 2015 8-hour average ozone NAAQS of 70 parts per billion (ppb) (Figure 1). In August 2019, EPA "bumped up" the classification of two nonattainment areas in the OTR to "serious" for the 2008 8-hour ozone NAAQS of 75 ppb. These areas are the New York-Northern New Jersey-Long Island nonattainment area and the Greater Connecticut nonattainment area.[3] Other OTC nonattainment areas are Philadelphia-Wilmington-Atlantic City, Baltimore, and Washington DC.

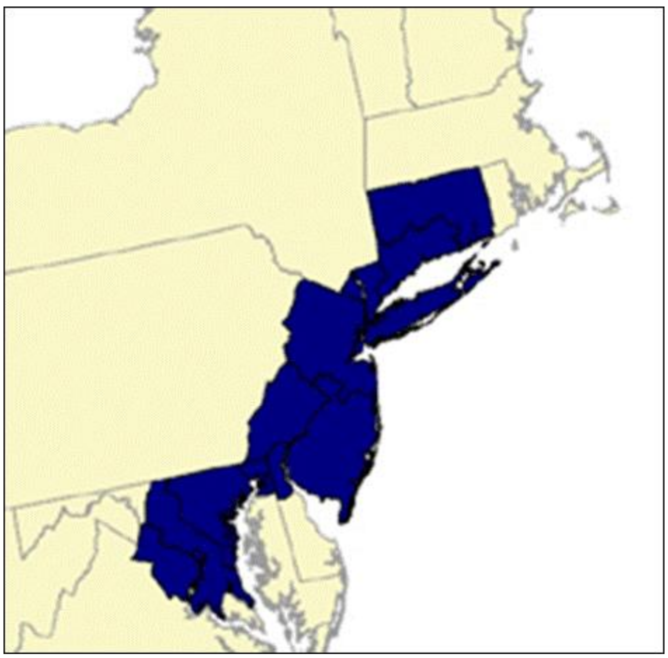

Figure 1. Ozone Nonattainment Areas in the OTR for the 70 ppb 8-Hour Average Ozone NAAQS.

[1] U.S. EPA, "Health Effects of Ozone Pollution," https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution, last updated July 30, 2019 (accessed February 7, 2020).

[2] Di, Q., *et al*. "Air pollution and mortality in the Medicare population." *New England Journal of Medicine* 376.26 (2017): 2513-2522. DOI: 10.1056/NEJMoa1702747; Di, Q., *et al*. "Association of short-term exposure to air pollution with mortality in older adults." *JAMA* 318.24 (2017): 2446-2456. DOI: 10.1001/jama.2017.17923.

[3] 84 Fed. Reg. 44238 (August 23, 2019).

While ozone is largely a summertime issue in the OTR, NOx emissions are a year-round problem due to its role in producing secondary $PM_{2.5}$ in the colder seasons. $PM_{2.5}$ exposure is associated with a variety of health effects, including: reduced lung function; irregular heartbeat; asthma attacks; heart attacks; and premature death in people with heart or lung disease.[4] The public health and environmental impacts of NOx are summarized in Table 1.

Table 1: Adverse Public Health and Environmental Impacts of NOx in the OTR.

Ozone and $PM_{2.5}$	• Reduces lung function, aggravates asthma and other chronic lung diseases • Can cause permanent lung damage from repeated exposures • Contributes to premature death
Acid deposition	• Damages forests • Damages aquatic ecosystems, e.g., Adirondacks and Great Northern Woods • Erodes manmade structures
Coastal and Marine Eutrophication	• Depletes oxygen in the water, which suffocates fish and other aquatic life in bays and estuaries, e.g., Chesapeake Bay, Narragansett Bay, and Long Island Sound
Visibility Impairment	• Contributes to regional haze that mars vistas and views in wilderness and urban areas

The Need for NOx Reductions in the Northeast and Mid-Atlantic

Parts of the OTR continue to experience persistently high ozone levels affecting tens of millions of people. The New York City (NYC) Combined Statistical Area (CSA) is the largest CSA by population in the United States, with over 23 million people living across portions of Connecticut, New Jersey, New York, and Pennsylvania. While air pollution levels have dropped over the years across much of the United States, the NYC metropolitan area and surrounding region continue to persistently exceed both past and recently revised federal health-based air quality standards for ground-level ozone. In addition, urban residents can be exposed to higher levels of health damaging $PM_{2.5}$ and air toxic pollutants concentrated at "hot-spots" in close proximity to high-density traffic arteries.

To address the region's persistent air quality problems, reducing NOx from heavy-duty truck engines is of the utmost importance due to its role in local and regional ground-level ozone formation, as well as its contributions to $PM_{2.5}$ (especially in the winter). An OTC analysis, shown in Figure 2, illustrates that onroad diesel vehicles, including heavy-duty vehicles (HDVs), are the largest NOx emissions source in the OTR. Emissions from highway trucks are estimated to comprise 20 percent of the region's total NOx emissions.

[4] U.S. EPA, "Health and Environmental Effects of Particulate Matter (PM)," https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm, last updated July 20, 2018 (accessed February 7, 2020).

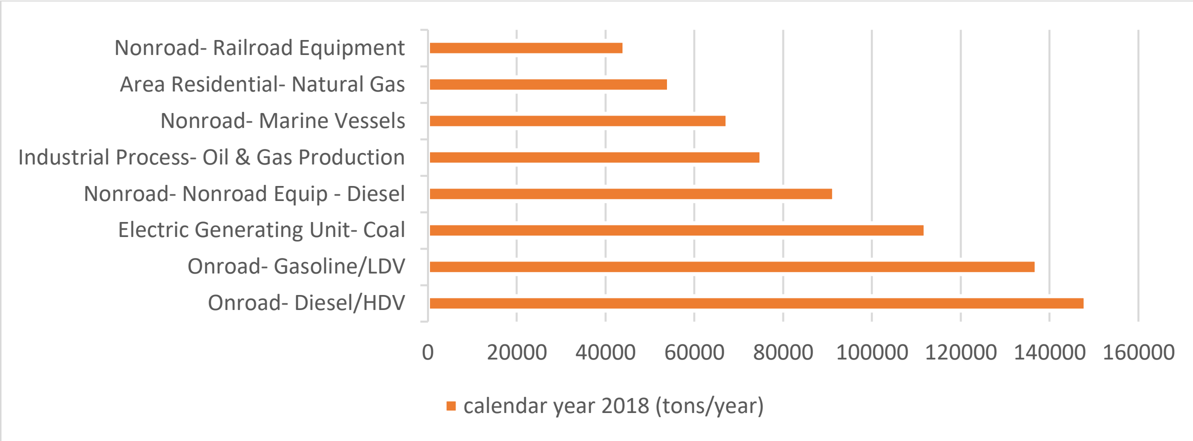

Figure 2: Modeled NOx Emissions in the OTR for Calendar Year 2018 (Source: OTC).

Moreover, the modeled NOx contribution from HDVs shown in Figure 2 is potentially underestimated, because the mobile source model used in developing the inventory does not account for high emitting heavy-duty trucks, such as glider vehicles and HDVs with tampered emission control systems. In-use testing data suggest that real-world NOx emissions are higher than modeled estimates, underscoring the need to achieve substantial NOx emission reductions from the heavy-duty diesel truck sector.[5]

To estimate the impact of onroad diesel emissions – the lion's share of which is emitted by HDVs – the OTC modeled the contribution of onroad diesel to 8-hour maximum ozone concentrations at monitors in the OTR.[6,7] An example is provided in Figure 3, which shows the modeled percent contribution to total ozone from onroad diesel vehicles at the Susan Wagner, NY monitor. At this monitor, onroad diesel is the second largest contributor to total ozone formed from controllable emission sectors.

[5] Tan, *et al.*, "On-Board Sensor-Based NOx Emissions from Heavy-Duty Diesel Vehicles," *Environmental Science and Technology*, 53: 5504-5511 (2019).
[6] Ozone Transport Commission "Technical Support Document for the 2011 Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union Modeling Platform - 2nd Revision," December 2018.
[7] The modeling evaluated the 8-hour maximum ozone on the 4th highest day, which is the metric EPA uses to evaluate compliance with the ozone NAAQS.

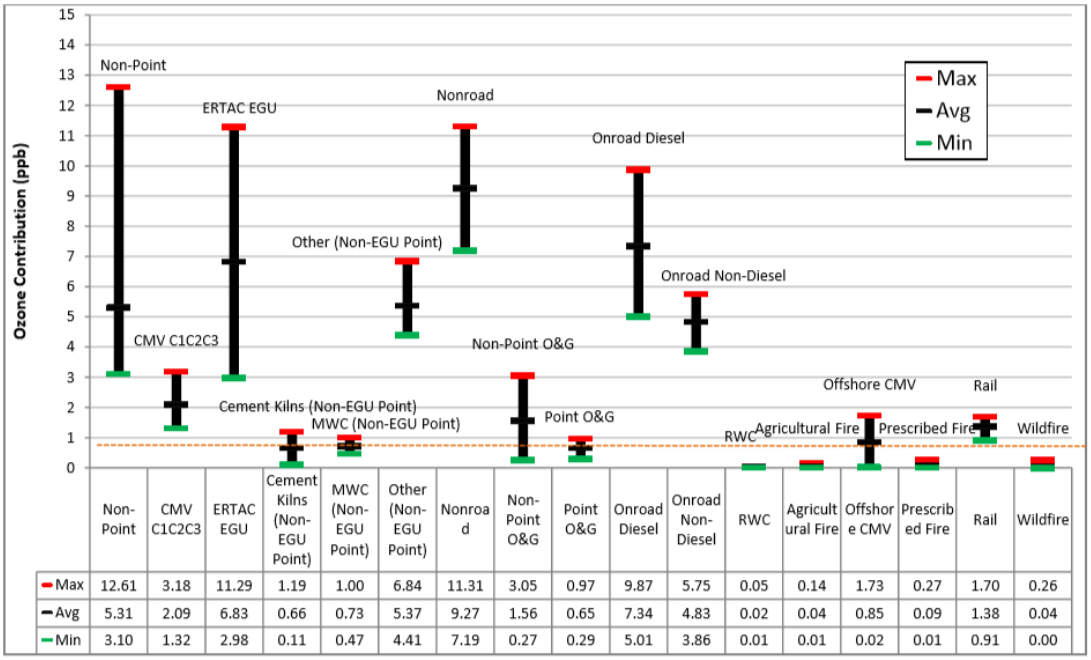

Figure 3: Maximum, Average, and Minimum Ozone Contributions by Sector on Exceedance Days at the Susan Wagner, NY Monitor.

Table 2 lists the percent contribution to total ozone from onroad diesels at additional monitors in the OTR. Onroad diesel emissions are projected to contribute up to 10 ppb to total ozone and the projected contribution makes up between 10 and 17 percent of controllable ozone contributions on these days. At these monitors, onroad diesels are consistently projected to be the second or third largest contributing sector to ozone.

Table 2: Projected Ozone Contribution from On-road Diesels at Selected Monitors (2023).

Monitor Location	State	Contribution (ppb)	Percentage Contribution to Ozone	On-Road Diesel Rank
Greenwich Point Park	CT	9.3	13.7 %	2
Bellevue State Park	DE	5.3	15.3 %	3
McMillan Reservoir	DC	9.2	15.3 %	2
Edgewood	MD	10.4	13.5 %	3
Ancora State Hospital	NJ	6.4	16.2 %	2
NEA	PA	6.1	16.0 %	3
W Greenwich	RI	5.0	13.5 %	2
Aurora Hills	VA	9.1	15.4 %	2

Absent adoption of stringent new engine NOx standards, emissions from HDV will increase in future years as truck vehicle miles traveled (VMT) grows. The Federal Highway Administration (FHWA) projects that HDV VMT will increase by approximately 20 percent over the next 25 years, as shown in Figure 3. This growth in VMT, if not counteracted by increased stringency of new engine emissions standards, will result in significantly increased heavy-duty truck emissions.

We also note that highway trucks often travel long distances and can be registered in states far from where they operate. Therefore, a strong national program is needed to reduce highway truck emissions that will maximize public health benefits in the OTC region and nationally.

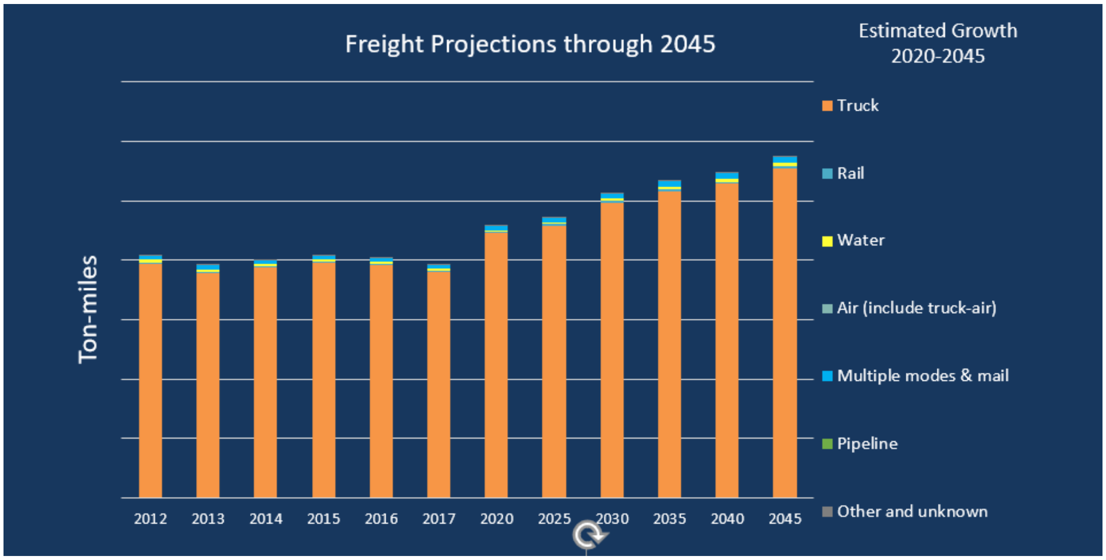

Figure 4: U.S. Freight Growth Projections from 2020 to 2045. Source: FHWA Freight Analysis Framework Data.[8]

Because of the importance of HDVs to air quality and public health in the OTR, in 2019, the OTC requested that EPA make the Cleaner Trucks Initiative one of its most urgent priorities.[9] EPA's response to a 2016 petition joined by a number of the OTC states recognizes the importance of NOx emission reductions for the OTC region and across the country.[10] In addition, EPA's *Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles –Phase 2* final regulation also detailed the importance of NOx reductions to the Northeast and Mid-Atlantic regions, stating that:

> EPA received compelling letters and comments from [NACAA, NESCAUM, OTC, and SCAQMD], explaining the critical and urgent need to reduce NOx emissions that significantly contribute to ozone and fine particulate air quality problems in their represented areas. The comments describe the challenges many areas face in meeting both the 2008 and recently strengthened 2015 ozone NAAQS. These organizations point to the significant contribution of heavy-duty vehicles to NOx emissions in their areas.[11]

The OTR had been making progress for over a decade at addressing its regional ozone problem, with ozone levels trending downward due to the adoption of measures that reduce emissions of ozone precursors. In recent years, however, air quality monitoring data no longer show a

[8] Oak Ridge National Laboratory, Center for Transportation Analysis, "Freight Analysis Framework Data Tabulation Tool (FAF4)," https://faf.ornl.gov/fafweb/Extraction1.aspx (accessed February 7, 2020).
[9] OTC letter to Andrew Wheeler, Administrator, U.S. EPA, re: Cleaner Trucks Initiative, August 28, 2019, https://otcair.org/upload/Documents/Correspondence/EPA%20NOx%20Letter.pdf.
[10] U.S. EPA, "Memorandum in Response to Petition to EPA for Rulemaking to Adopt Ultra Low NOx Exhaust Emission Standards for On-Road Heavy-Duty Trucks and Engines," December 20, 2016. Available at https://www.epa.gov/sites/production/files/2016-12/documents/nox-memorandum-nox-petition-response-2016-12-20.pdf (accessed February 7, 2020).
[11] 81 Fed. Reg. 73478 at 73523 (Oct. 25, 2016).

declining trend. Figure 5 shows the number of days in Connecticut where maximum 8-hour ozone was measured above the 2008 and 2015 ozone NAAQS for each year from 1976 to 2018. After significant improvements in the earlier years, the number of high ozone days in Connecticut have remained level or have slightly increased since 2011. Similar patterns have been recorded in other OTC states, as can be seen in Figure 6.

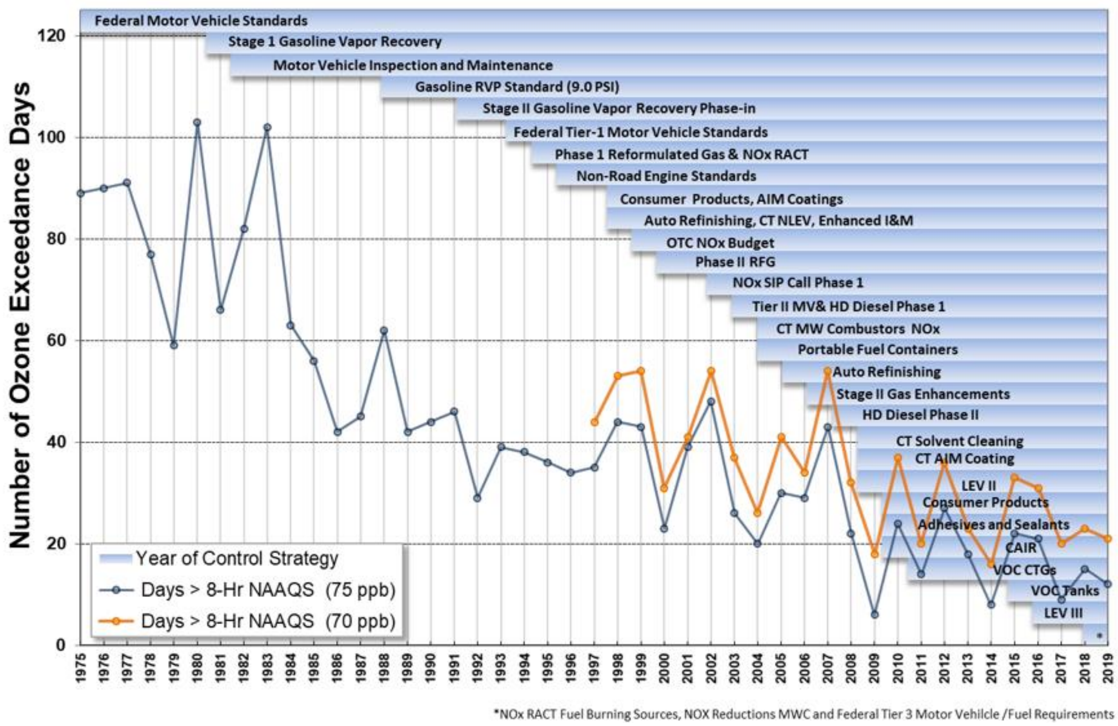

Figure 5: Connecticut 8-Hour Ozone Exceedance Trends and Implemented NOx Control Measures.

As noted previously, the Greater Connecticut and New York-Northern New Jersey-Long Island ozone moderate nonattainment areas failed to meet the deadline for attainment of the 2008 ozone NAAQS (75 ppb) and were re-designated to serious nonattainment status for that NAAQS. These areas must now meet the attainment date of 2021 for the 2008 standard. In addition, the Philadelphia-Wilmington-Atlantic City nonattainment area for the 2008 8-hour ozone NAAQS previously qualified for a clean-data determination, but is now again exceeding that NAAQS.

Not only have ozone design value improvements stalled, the region has experienced unusually high peak ozone concentrations in recent years. In July of 2018, the New York City metropolitan region saw a 1-hour ozone average of 143 ppb, a peak level not seen in this area in more than 10 years.

Figure 5 also includes an extensive list of requirements that have been adopted in Connecticut and other OTC states to reduce emissions of ozone precursors from stationary sources, area sources, fuels, mobile sources, and consumer products. Imposing further control requirements on many of these source categories would be more costly than controlling heavy-duty engine emissions and would create disproportionate economic burden for those sources. The OTC estimated the cost of additional NOx controls for industrial, commercial, and institutional boilers (100 million British Thermal Units per hour in size) ranges from $2,700 to $21,000 per ton of NOx reduced as compared to a cost range of $1,000 to $5,000 per ton of NOx reduced from HDVs.[12,13]

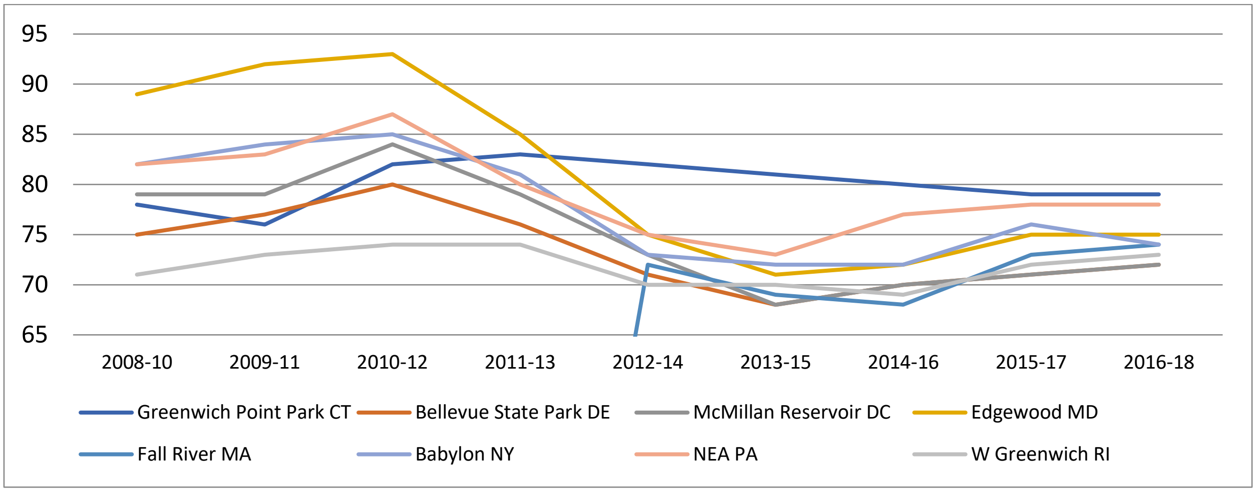

Figure 6: Ozone Design Values from Selected Monitors in the OTR from 2008-10 to 2016-18.

The satellite imagery in Figure 7 readily shows visible nitrogen dioxide (NO_2) pollution (a major component of NOx) along the Northeast Corridor, with the highest concentrations of NO_2 in the New York City area. The figure shows the NO_2 vertical column concentration measured during daily overpasses by the TROPOMI satellite for weekdays (Monday-Friday) during May through September in 2018. Much of the NO_2 pollution is near the surface close to its emission sources. High density ground level NOx emissions in large urban areas not only reacts to create low elevation ozone, but also mixes upward into higher altitudes, which is shown in the NO_2 vertical column measurements. Power plants in some locations enhance the vertical column measurements as many of them inject their emissions into higher altitudes. As a result, low-level emissions such as those from HDVs are an important component to local ozone production while power plant emissions have a greater relative tendency to cause downwind ozone production.

[12] OTC/Lake Michigan Air Directors Consortium (LADCO), "Evaluation of Control Options for Industrial, Commercial and Institutional (ICI) Boilers," May 2010.
[13] Manufacturers of Emission Controls Association, "Technology Feasibility for Heavy-Duty Diesel Trucks in Achieving 90% Lower NOx Standards in 2027," February 2020. Available at: http://www.meca.org/resources/MECA_2027_Low_NOx_White_Paper_FINAL.pdf (accessed February 7, 2020).

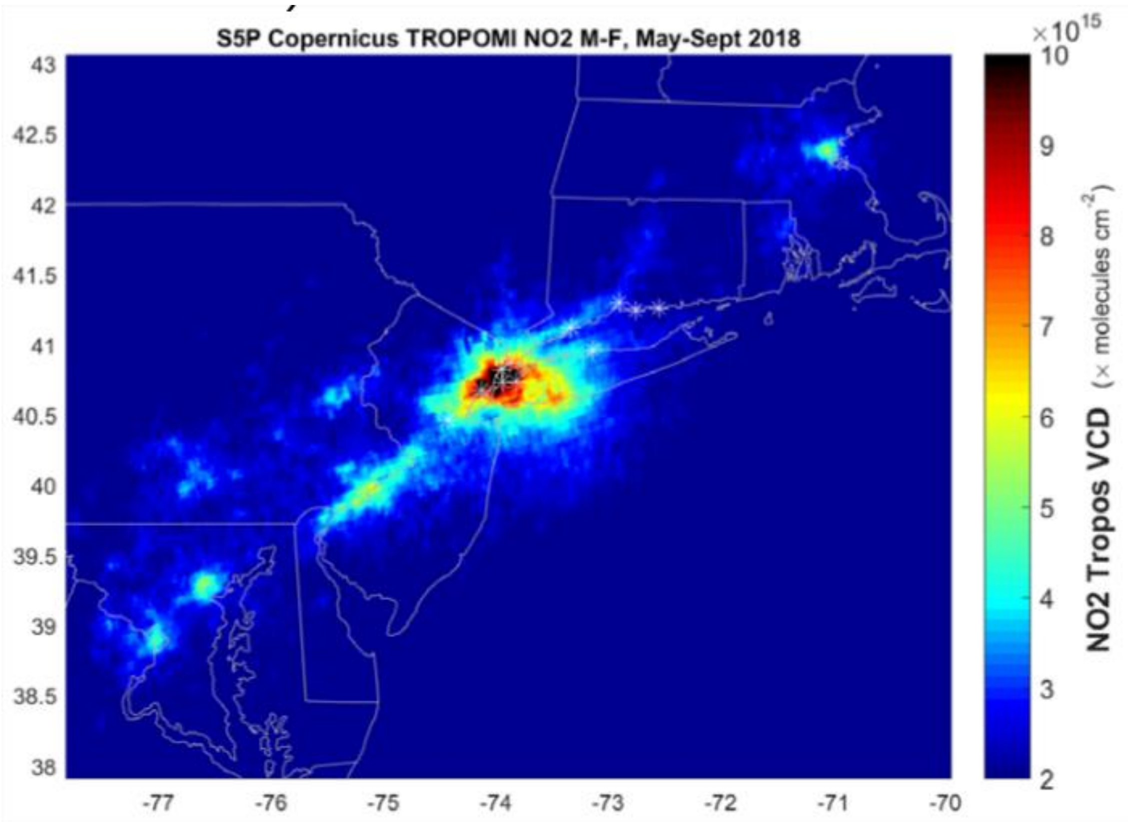

Figure 7: TROPOMI Satellite Imagery Showing High NO_2 Concentrations in the Northeast Corridor.

Figure 8 shows satellite imagery of NO_2 concentrations during the winter in the Northeast and Mid-Atlantic on a day during February 2019 with particularly severe haze. NO_2 concentrations are abundant and dominant along the I-91/95 corridor from Virginia to Massachusetts, suggesting a strong mobile source NOx contribution. These are major arteries where goods are being transported by truck from the ports of Baltimore, Philadelphia, and New York. Note how clearly defined the area of red is along I-91 in Connecticut and Massachusetts. In addition to region-wide stagnation on this particular day, the strength of the NO_2 signal also reflects the longer NO_2 lifetime in winter.

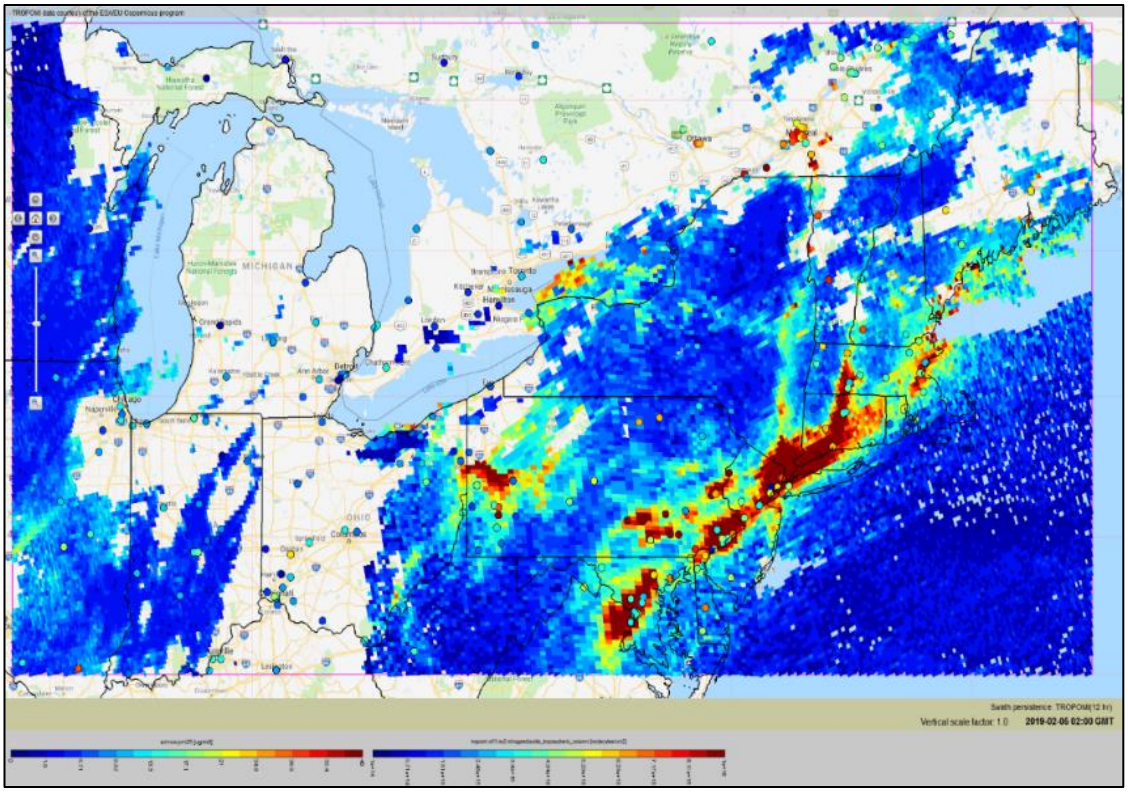

Figure 8: TROPOMI Satellite Data of Wintertime NO_2 – Virginia to Massachusetts.

Because of its role in secondary particulate formation, reducing HDV NOx emissions could improve visibility in MANE-VU Class Federal I areas. There are seven Class I Federal areas in the region which have historically faced some of the worst visibility in the nation. Monitor analyses of the IMPROVE network shows the increasing importance of nitrate formation on visibility impairment, in particular at the Brigantine Wilderness Area in the Edwin B. Forsythe National Wildlife Refuge, NJ.[14] In addition, as was shown in Figure 2, HDVs are the largest emitter of NOx emissions in the region. Because of this, the MANE-VU states through the MANE-VU Regional Planning Organization process requested that EPA implement a program to reduce NOx emissions from HDVs.[15]

Recommendations

Emission standards for medium- and heavy-duty trucks were last finalized in 2001, nearly 20 years ago. Since then, extensive experience in implementation and monitoring has provided a substantial body of evidence supporting more stringent standards over the Federal Test Procedure (FTP) and Ramped Modal Cycle (RMC). Recent studies and modeling analyses support the introduction of a heavy-duty engine FTP and RMC NOx exhaust emission standard

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[14] Mid-Atlantic/Northeast Visibility Union. "Mid-Atlantic/Northeast U.S. Visibility Data 2004-2017 (2nd RH SIP Metrics)," December 18, 2018.

[15] Mid-Atlantic/Northeast Visibility Union. "Statement of the MANE-VU States Concerning a Course of Action by the Environmental Protection Agency and Federal Land Managers toward Assuring Reasonable Progress for the Second Regional Haze Implementation Period (2018-2028)," August 25, 2017.

that is 90 percent more stringent by model year 2027 than today's standard of 0.20 grams per brake horsepower hour (g/bhp-hr).[16,17]

Advanced catalyst formulations, passive and active thermal management strategies, approaches to reducing pumping losses, engine calibration and hardware changes, and electrification are examples of technologies that can be used to reduce NOx emissions to a level of 0.02 g/bhp-hr in 2027 while maintaining carbon dioxide emissions at levels required by the Phase 2 heavy-duty greenhouse gas (GHG) standards. Some of these technologies will most likely be explored prior to model year 2027 to meet the EPA Phase 2 GHG and CARB 2024 Low NOx programs.

Given the importance of controlling NOx emissions from heavy-duty engines, we offer the following recommendations on the elements detailed in the ANPR, which we believe are necessary to ensure a robust regulation that delivers substantial heavy-duty engine emissions reductions.

- Require a new engine NOx emission standard of 0.02 g/bhp-hr on the FTP and RMC for model year 2027 and later engines;
- Require a new engine PM emission standard of 5 milligrams/bhp-hr on the FTP and RMC cycles for model year 2027 and later engines;
- Introduce a low load certification test cycle and require an engine exhaust emission limit of 0.075 g/bhp-hr NOx or lower for model year 2027 and later engines;
- Introduce an idle cycle for new engine certification and require an engine exhaust emissions limit of 10 g/hr NOx or less for model year 2027 and later engines;
- Replace the current Not-to-Exceed in-use test protocol with a moving average window approach, and maintain the requirement for $PM_{2.5}$ in-use testing; and
- Increase the useful life and warranty requirements for heavy-duty engines.

We stand ready to assist EPA in the development of this important regulation.

Sincerely,

Shawn M. Garvin
Secretary, Delaware Department of Natural Resources & Environment Control
OTC Chair

Emily Boedecker
Commissioner, Vermont Department of Environmental Conservation
MANE-VU Chair

cc: OTC/MANE-VU Commissioners and Air Directors
U.S. EPA Regional Administrators for Regions I, II, and III

[16] Manufacturers of Emission Controls Association, "Technology Feasibility for Heavy-Duty Diesel Trucks in Achieving 90% Lower NOx Standards in 2027," February, 2020. Available at http://www.meca.org/resources/MECA_2027_Low_NOx_White_Paper_FINAL.pdf (accessed February 7, 2020).

[17] Southwest Research Institute, "Update on Heavy-Duty Low NOx Demonstration Programs at SwRI," November 2019. Available at https://ww3.arb.ca.gov/msprog/hdlownox/files/workgroup_20190926/guest/swri_hd_low_nox_demo_programs.pdf. (accessed February 7, 2020).