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August 30, 2023

Katie Dykes
Commissioner
Connecticut Department of Energy and Environmental Protection
Via electronic mail: deep.mobilesources@ct.gov cc: Katie.Dykes@ct.gov

Dear Commissioner Dykes,

On behalf of the Sierra Club and our more than 40,000 members and supporters in Connecticut, thank you for the opportunity to provide public comment in support of Connecticut's adoption of the Advanced Clean Truck (ACT) and Heavy-Duty Low NOx Omnibus (HDO) regulations.

The Sierra Club is committed to defending everyone's right to a healthy world by tackling the serious challenges of a warming climate and the harmful effects of pollution. Transportation pollution in Connecticut is a serious problem for public health, environmental justice, and our climate. The transportation sector accounts for approximately 39% of greenhouse gas emissions[1] in Connecticut and is a major source of ground level air pollutants that harm public health. Connecticut has a persistent ozone pollution problem and transportation emissions are contributing to this. Adoption of the ACT and HDO regulations is a critically needed tool to cut pollution from transportation and protect the air we breathe, the health of our residents, and the climate. The policy will function as a gradual but guaranteed way to increase the percentage of electric medium- and heavy-duty vehicles (MHDVs) on Connecticut's roads and decrease the percentage of polluting diesel trucks.

Eight states have already adopted the ACT rule and seven have adopted the HDO rule including Colorado, New Jersey, New York, Massachusetts, Oregon, Washington, Vermont, and California. Several more states are considering adoption or are in the process of finalizing them, including New Mexico, Maryland, North Carolina, and Maine. Connecticut should join these states in adopting these regulations in 2023.

<u>Pollution reduction</u>

In Connecticut, big trucks and buses makeup just 6% of all on-road[2] vehicles but are responsible for 25% of the economy-wide greenhouse gas emissions, over 50% of all smog forming NOx pollution and 45% of the diesel soot, also known as fine particulate matter.

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[1] https://portal.ct.gov/-/media/DEEP/climatechange/1990-2021-GHG-Inventory/DEEP_GHG_Report_90-21_Final.pdf
[2] https://portal.ct.gov/-/media/DEEP/air/mobile/MHD/MHD_Whitepaper_030822.pdf

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Connecticut's Global Warming Solutions Act requires an economy-wide reduction in greenhouse gas emissions of 45% by 2030 and 80% by 2050. According to Connecticut's Department of Energy & Environmental Protection's recent Greenhouse Gas (GHG) Emissions Inventory[3], the transportation sector accounts for approximately 39% of the state's total emission profile and remains the largest source with emissions at the same level as 1990. Connecticut is not on track to meet the 29% reduction of emissions in the transportation sector that the Governor's Council on Climate Change determined is crucial to meet the Global Warming Solutions Act 2030 goal. Adopting the ACT and HDO will reduce carbon emissions by over 350,000 tons per year in 2050.

Data from the International Council on Clean Transportation (ICCT) illustrates the emissions benefits adoption of the ACT and HDO rules would bring to Connecticut.[4] The table below shows the estimated cumulative emissions avoided between 2020 and 2050 with ACT and HDO adoption in Connecticut as compared to a Business as Usual (BAU) emissions scenario, including 15.45 million metric tons of CO2e, 126 U.S. tons of PM 2.5, and 20,510 U.S. tons of NOx.

Table 2. Cumulative M/HD emissions benefits in Connecticut compared to BAU, 2020–2050

Program	Cumulative emissions reduction		
	NO_x (U.S. tons)	$PM_{2.5}$ (U.S. tons)	CO_2e (MMT*)
ACT	14,730	126	15.45
HDV omnibus	9,890	N/A	N/A
ACT + HDV omnibus	20,510	126	15.45
ACT + HDV omnibus + 100% HD ZEV sales in 2040	25,148	194	20.21

*million metric tons

The figure below, also from the ICCT,[5] further shows that a business-as-usual case in Connecticut results in an unacceptable increase in GHG emissions from heavy-duty vehicles through 2050, which would prohibit Connecticut from meeting its climate mandates.

[3] https://portal.ct.gov/-/media/DEEP/climatechange/1990-2021-GHG-Inventory/DEEP_GHG_Report_90-21_Final.pdf
[4] International Council on Clean Transportation, Benefits of adopting California's Advanced Clean Truck Program, Heavy Duty Vehicle Omnibus Standards and a 100% sales requirement in Connecticut, September 2022, https://theicct.org/wp-content/uploads/2022/09/HDV-fact-sheet-CT-092122.pdf.
[5] *Id.*

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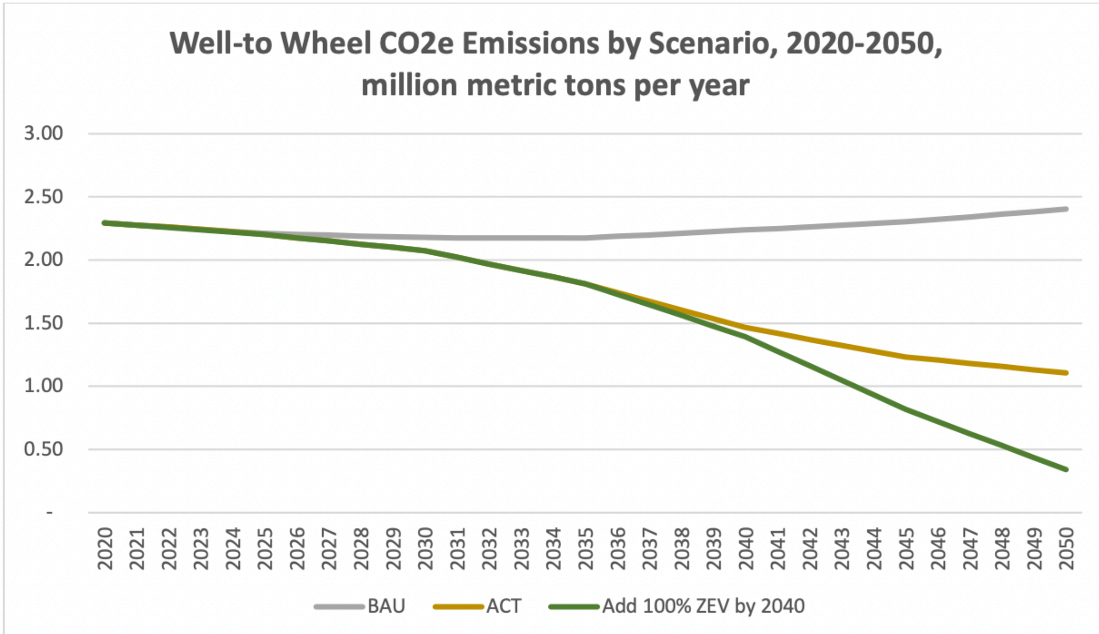


Figure 3. Well-to-wheel HDV CO_2e emissions by scenario 2020–2050

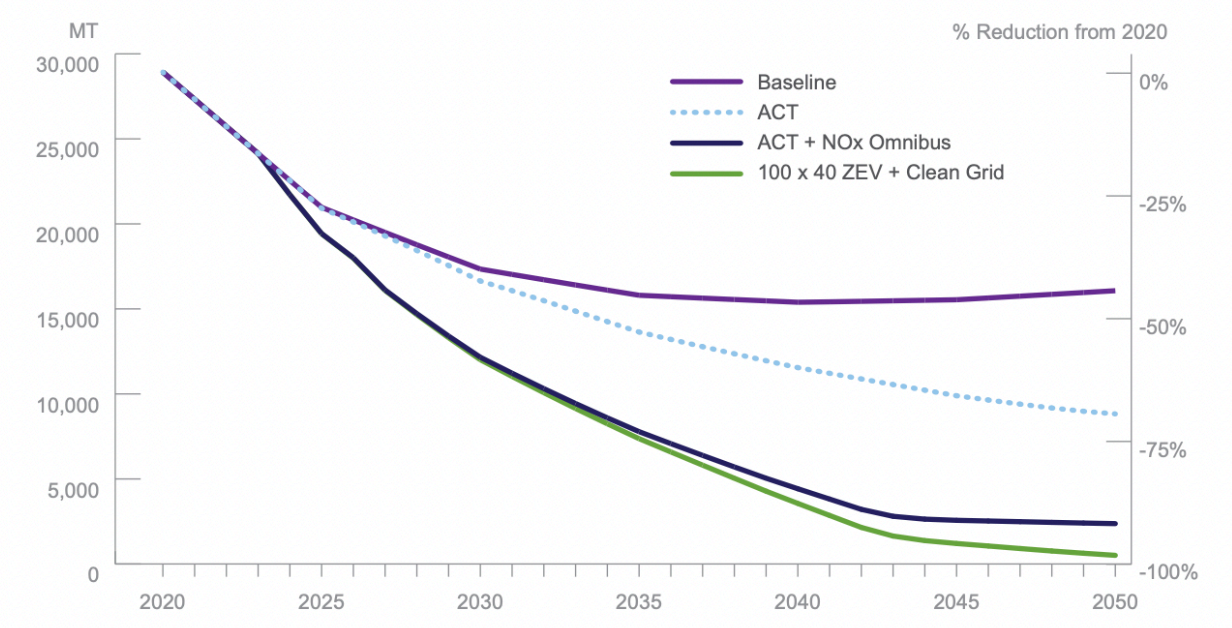
Connecticut has persistently been designated as a nonattainment area for National Ambient Air Quality Standards (NAAQS) for ozone.[6] For the purposes of EPA classification, Connecticut is divided into two nonattainment areas for ozone: the southwest portion of the state (the Connecticut portion of the New York-New Jersey-Connecticut area) and the remainder of the state (Greater Connecticut). On November 7, 2022, New Haven and Middlesex Counties were reclassified from serious to severe nonattainment with respect to the 2008 ozone NAAQS,[7] highlighting that harmful ozone pollution is a persistent problem in the state. By adopting both the ACT and HDO regulations, Connecticut can reduce NOx, a precursor to ozone, by 86%.[8]

The ACT and HDO rules will be critical to reducing the NOx emissions from on-road sources in Connecticut that contribute to the state's ozone nonattainment status. MHDVs in Connecticut contribute 53% of total on-road NOx emissions in the state.[9] As illustrated in the figure below, produced by MJ Bradley as part of its report, *Southern New England Clean Trucks Program: An Analysis of the Impacts of Zero-Emission Medium- and Heavy-Duty Trucks on the Environment, Public Health, Industry, and the Economy*, the ACT rule is estimated to reduce annual fleet NOx

[6] https://portal.ct.gov/DEEP/Air/Planning/Ozone/Ozone-Planning-Efforts
[7] https://portal.ct.gov/-/media/DEEP/air/ozone/Maps/SW-CT-2008-Ozone-Severe-Bump-up.pdf
[8] https://www.ucsusa.org/sites/default/files/2022-01/ct-clean-trucks-fact-sheet.pdf
[9] M.J. Bradley and Associates, Southern New England Clean Trucks Program, An Analysis of the Impacts of Zero-Emission Medium- and Heavy-Duty Trucks on the Environment, Public Health, Industry, and the Economy, 2021, p. 36, available at https://www.ucsusa.org/sites/default/files/2021-11/southern-ne-clean-trucks-report.pdf.

emissions by 45 percent by 2050 beyond the business-as-usual case in Southern New England.[10] The HDO Rule will further lower annual NOx emissions as the diesel and gasoline portion of the fleet transitions to new low-NOx vehicles, reducing annual NOx emissions by 85 percent by 2050 compared to the baseline if both the ACT and HDO rules are adopted.[11]

Figure 3 Projected M/HD Fleet NOx Emissions



Environmental justice

Low-income communities and communities of color bear an unfair burden of medium and heavy duty truck pollution, having suffered generations of systematic marginalization that forces frontline communities to live closer to warehouses, transit centers and highways. Hartford, Bridgeport and New Haven are ranked among the top 100 most challenging places to live with asthma in the United States.[12] In "An Assessment of Connecticut's Need to Adopt California's Medium and Heavy-Duty Vehicle Emission Standards[13]", DEEP concluded that electrification of medium and heavy duty vehicles will greatly benefit the most vulnerable populations in the state by providing an immense reduction in CO2 and NOx emissions in communities overburdened by transportation pollution.

[10] *Id.* at 14.
[11] *Id.*
[12] https://aafa.org/wp-content/uploads/2022/10/aafa-2022-asthma-capitals-report.pdf
[13] https://portal.ct.gov/-/media/DEEP/air/mobile/MHD/MHD_Whitepaper_030822.pdf

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Public health

Adoption of these rules will not only help Connecticut reduce NOx emissions and related ozone pollution for purposes of compliance with the NAAQS, it will lead to significant real-world public health benefits in the state. The public health impacts of NOx pollution include lung infections, and breathing problems for people with lung diseases, like asthma and chronic obstructive pulmonary disorder (COPD). Fine particulate matter contributes to early death[14] attributed to cardiovascular diseases, like heart attacks and strokes, as well as lung cancer, reproductive and developmental harm, and dementia[15]. It is estimated that up to 11% of all asthma emergency room visits in the United States are attributed to ozone.[16]

Recent analysis[17] by the American Lung Association found that by adopting the ACT, Connecticut can see $10.5 billion in cumulative health benefits between 2020-2050, avoid 963 premature deaths, 21,402 asthma attacks, and 111,710 lost work days. A study by ERM[18] found that by adopting both the ACT and HDO regulations, Connecticut can reduce NOx by 86%, PM2.5 by 27%, avoid 102 hospital visits, and prevent 104 premature deaths. While recently adopted federal standards for diesel engines will provide some of these emission and health benefits, Connecticut's adoption of ACT and HDO will ensure that the state benefits from both a transition to zero emission trucks and cleaner combustion engines. Adopting regulatory programs like ACT was noted as "one of the most effective tools available" to accelerate zero-emission health benefits in the Multi-State Medium- and Heavy-Duty Action Plan issued by the Northeast States Coordinated Air Use Management (NESCAUM) in July 2022.

Availability of vehicles

Adopting the ACT and HDO advances the market for zero-emission medium- and heavy-duty vehicles in our state. Connecticut would join eight other states in adopting the ACT and seven other states in adopting the HDO; the more states that adopt the rules, the greater the market-forcing benefits, thereby lowering costs and creating a more stable and self-sustaining market. The ACT does not require purchase of zero-emission vehicles under the rule, it only requires manufacturers to make them available for sale. In July 2023, the Engine Manufacturers Association (EMA) announced a commitment to meet the ACT standard of 100% clean truck sales by 2045.

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[14] https://www.lung.org/our-initiatives/healthy-air/outdoor/air-pollution/particle-pollution.html
[15] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(16)32399-6/fulltext
[16] Susan C. Anenberg et al., Estimates of the Global Burden of Ambient PM 2.5 , Ozone, and NO 2 on Asthma Incidence
and Emergency Room Visits, 126(10) Env't Health Persp. 107004 (Oct. 2018).
[17] https://www.lung.org/getmedia/e1ff935b-a935-4f49-91e5-151f1e643124/zero-emission-truck-report
[18] https://www.ucsusa.org/sites/default/files/2022-01/ct-clean-trucks-fact-sheet.pdf

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It will be cheaper to own electric trucks than new diesel trucks within just four years.[19] To assist businesses in the transition to zero-emission medium- and heavy- duty vehicles, Connecticut has enabled funding through the CHEAPR rebate program.

Economic benefits

By the year 2050, the ERM study also found that deploying ACT and HDO rules could deliver up to $893 million each year and Connecticut's population could cumulatively save up to $1.4 billion in health expenses.[20] The rules can stimulate the creation of high-quality zero-emission manufacturing and charging installation jobs in our state.

Increased EV adoption will further benefit all Connecticut residents in terms of electricity rates, regardless of whether they are EV owners, because EVs drive electricity costs down for all ratepayers. EVs present significant opportunity to reduce electricity costs for all customers by spreading utility fixed costs over a greater quantity of kilowatt-hour sales, particularly if the additional load occurs during off-peak times.[21] Analysis by Synapse Energy Economics, Inc. of empirical evidence from the two utility service territories with the highest EV penetrations in the country (Pacific Gas & Electric's and Southern California Edison's service territories in California) shows that EV load puts downward pressure on rates: over eight years from 2012-2019, EV drivers in these service territories contributed $806 million more in revenues than associated costs, and drove rates down for all customers.[22] As Synapse concluded, "in the two utility service territories with the most EVs in the US, EVs have increased utility revenues more than they have increased utility costs—leading to downward pressure on electric rates for EV-owners and non-EV owners alike."[23] Importantly, Synapse's analysis shows that EVs generated more utility revenue than costs and put downward pressure on rates even when most customers were on traditional tiered rates and these benefits were amplified when time of use rates were implemented.[24] Similar benefits are expected in Connecticut as the state accelerates transportation electrification and optimizes charging loads to occur during off-peak hours.

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[19] https://www.edf.org/media/new-study-finds-rapidly-declining-costs-zero-emitting-freight-trucks-and-buses
[20] https://www.ucsusa.org/sites/default/files/2021-11/southern-ne-clean-trucks-report.pdf
[21] Synapse Energy Economics, *Electric Vehicles Are Driving Electric Rates Down* (June 2020 Update), available at https://www.synapse-energy.com/sites/default/files/EV_Impacts_June_2020_18-122.pdf#:~:text=EVs%20hold%20significant%20potential%20to%20reduce%20electric%20rates,the%20day%20when%20the%20electric%20grid%20is%20underutilized.
[22] *Id.*
[23] *Id.*
[24] *Id.*

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Thank you for your attention to these important issues and consideration of our testimony.

Sincerely,

Samantha Dynowski, State Director
Sierra Club Connecticut

Enclosures:

1. "Implementation of ACC II and ACT, and HDO Rules in Connecticut's Ozone NAAQS Nonattainment Areas: How Vehicles Contribute to Detrimental Public Health and Environmental Justice Concerns"
2. Lynn Alley and Kenneth Craig, Sonoma Technology, "Analysis of Air Quality Impacts from Onroad Mobile Sources on Ozone Nonattainment areas in Connecticut, Illinois, Maryland, Michigan, New Jersey, and Pennsylvania," May 19, 2023.

August 23, 2023

Implementation of ACC II and ACT, and HDO Rules in Connecticut's Ozone NAAQS Nonattainment Areas: How Vehicles Contribute to Detrimental Public Health and Environmental Justice Concerns

The Department of Energy and Environmental Protection's ("DEEP") adoption of the Advanced Clean Cars II ("ACC II") Rule, the Advanced Clean Trucks ("ACT") Rule, and the Heavy-Duty Engine and Vehicle Omnibus ("HDO") Rule, and incorporation of these rules into Connecticut's ozone air quality State Implementation Plan ("SIP"), would represent a critical step in meeting the Lamont Administration's goals to improve conditions in Connecticut's environmental justice communities that are overburdened by pollution. In addition, this would allow the state to meet Connecticut's climate commitment to reduce greenhouse gas ("GHG") emissions by 45% below 2001 levels by 2030, and 80% below 2001 levels by 2050.[25]

These rules are critical to addressing Connecticut's long-standing air quality attainment challenges and putting the state in a position to potentially redesignate the New York-Northern New Jersey-Long Island ("NY-NJ-CT") and Greater Connecticut ("Greater CT") areas to attainment. The Greater CT area, which includes Hartford, Litchfield, New London, Tolland, and Windham Counties, is currently designated as Moderate Nonattainment under the 2015 8-hour National Ambient Air Quality Standards ("NAAQS") issued by the U.S. Environmental Protection Agency ("EPA"), as is Southwestern Connecticut, which includes Fairfield, Middlesex, and New Haven Counties, and is part of the NY-NJ-CT nonattainment area.[26]

Almost 6.2 million Connecticut residents, comprising 100% of Connecticut's population, continue to live in areas that are designated as failing to meet EPA's health-based NAAQS.[27] High ozone levels have documented adverse health impacts, including higher levels of asthma and asthma morbidity.[28] Ozone formation in Connecticut is traceable in significant part to emissions of nitrogen oxides ("NOx"), which are released by the combustion of gasoline and diesel fuel in Connecticut's vehicles. Over a third of Connecticut's total NOx emissions, approximately 36.9%, are attributable to pollution from vehicles driving on Connecticut's roads.[29]

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[25] *See* 2022 Conn. Pub. Acts 22-5(a).
[26] EPA, *8-Hour Ozone (2015) Designated Area/State Information* (Mar. 31, 2023), https://www3.epa.gov/airquality/greenbook/jbtc.html. This area is still designated as nonattainment under the 2008 8-hour ozone NAAQS, but these comments are focused on the nonattainment designation under the more recent 2015 NAAQS. *See* EPA, *8-Hour Ozone (2008) Nonattainment Area Area/State/County Report* (Mar. 31, 2023), https://www3.epa.gov/airquality/greenbook/hnca.html.
[27] *See infra* Section I.a.
[28] *See infra* Section I.b.
[29] *See infra* Section II.a.

Recent modeling commissioned by the Sierra Club confirms the massive contribution of on-road vehicles to ozone pollution in Connecticut. On-road vehicles in the state have contributed up to 5.48 parts per billion ("ppb") of ozone on a given ozone nonattainment day, which means that up to 7.83% of the total minimum federal air quality standard of 70 ppb of ozone is driven by pollution from in-state vehicles alone.[30]

Connecticut's historically high ozone levels are exacerbating race- and income-based health disparities and have a major impact on Connecticut's environmental justice communities. For example, EPA's EJScreen tool indicates that New Haven, Connecticut is in the 87th percentile nationally for the ozone EJ index, an index that combines ozone levels with demographic data (by averaging populations of low-income people and people of color).[31] In other words, only 13% of the U.S. population has worse ozone pollution impacts than New Haven, considering the demographic factors of income and race.[32] Emergency department visits for asthma are over five times higher for Black children than white children in Connecticut.[33, 34] Reducing NOx emissions, an ozone precursor, is therefore essential for mitigating the adverse and unjust health impacts affecting Connecticut residents.

The implementation of the ACC II, ACT, and HDO Rules will reduce NOx emissions from Connecticut's on-road vehicles tremendously, as well as greenhouse gas emissions. Adopting these rules is therefore critical for bringing Connecticut back into compliance with legally binding federal NAAQS standards and Connecticut's own GHG reduction requirements, as set forth in the state's Act Concerning Climate Change Mitigation.[35] Modeling reveals that with adoption of the ACT Rule alone, Connecticut could cumulatively reduce tailpipe NOx emissions from medium- and heavy-duty vehicles by 13,300 metric tons by 2050. If the State were to adopt both HDO and ACT Rules, Connecticut could benefit from a reduction of over 18,600 metric tons of NOx emissions by 2050. By implementing the ACT Rule, Connecticut would avoid 15.45 million metric tons of greenhouse gas emissions by 2050.[36] Accordingly, this combination of legal standards provides the most effective, equitable remedy for reducing the heavy levels of pollution emanating from Connecticut's vehicles.

The ACC II Rule is a critical tool in reducing emissions because it requires gradual increases in the sales of zero-emission light-duty vehicles, while the ACT Rule requires increasing sales of zero-emission medium- and heavy-duty vehicles. The HDO Rule serves the important function of internalizing the costs of pollution from medium- and heavy-duty vehicles by requiring reduced NOx emissions from those vehicles. We urge Connecticut to expeditiously finalize adoption of these rules and incorporate them into the State's federally-enforceable moderate ozone nonattainment SIP.

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[30] *See infra* Section II.b.1.
[31] EPA, *EJ and Supplemental Indexes in EJScreen*, https://www.epa.gov/ejscreen/ej-and-supplemental-indexes-ejscreen.
[32] *Id.*
[33] *See infra* Section I.c.
[34] Note, the "w" in white is intentionally lowercase for these comments, whereas the "b" in Black is capitalized for reasons explained hereafter. *See* Kwame Anthony Appiah, *The Case for Capitalizing the* B *in Black*, The Atlantic, (June 18, 2020), https://www.theatlantic.com/ideas/archive/2020/06/time-to-capitalize-blackand-white/613159/.
[35] 2004 Conn. Pub. Acts No. 22-5.
[36] Greenhouse gas emissions results quantify well-to-wheel CO_2e emissions under the ACT rule. *See supra* note 62.

I. Connecticut Residents Continue to Experience High Ozone Levels in Excess of Minimum National Ambient Air Quality Standards, Particularly in Urban Areas and in Communities of Color

Connecticut, for years, has had a persistent problem with high levels of ozone pollution in excess of health-based national ambient air quality standards. As reflected below, Connecticut residents continue to live in nonattainment areas that have regularly experienced air that EPA has determined is unsafe to breathe. This disproportionate burden of pollution results in inequitable, poorer health outcomes among disadvantaged communities of color.

a. All Connecticut Residents Live in Nonattainment Areas Where Ozone Levels Regularly Exceed Health-Based Limits Set by NAAQS

High ozone levels are a persistent public health issue in Connecticut, with all of Connecticut's residents living in areas that are failing to attain safe, healthy levels of ozone. However, certain urban areas bear the brunt of this, such as the state's third largest city of New Haven. With a population of approximately 135,000,[37] New Haven is home to some of the state's most vulnerable, including a low-income population that falls within the 87th percentile for the ozone EJ index nationally.[38]

The State of Connecticut's nonattainment areas have continued to log high 8-hour daily ozone values, reaching as high as 100 ppb in 2016, as well as 99 ppb in 2018 and 2021.[39] Both the Greater Connecticut and NY-NJ-CT areas have continuously exceeded the ozone NAAQS each year. While the 8-hour daily ozone maximum values and the number of days with exceedances improved slightly in 2022, Connecticut needs to improve and maintain its most recent gains in air quality in order to continually attain the ozone NAAQS. Again, even as recently as 2022, ozone levels reached 88 ppb–18 ppb above the federal 70 ppb standard–and New Haven County exceeded the 70 ppb limit on nearly a dozen days or more per year until 2022.[40]

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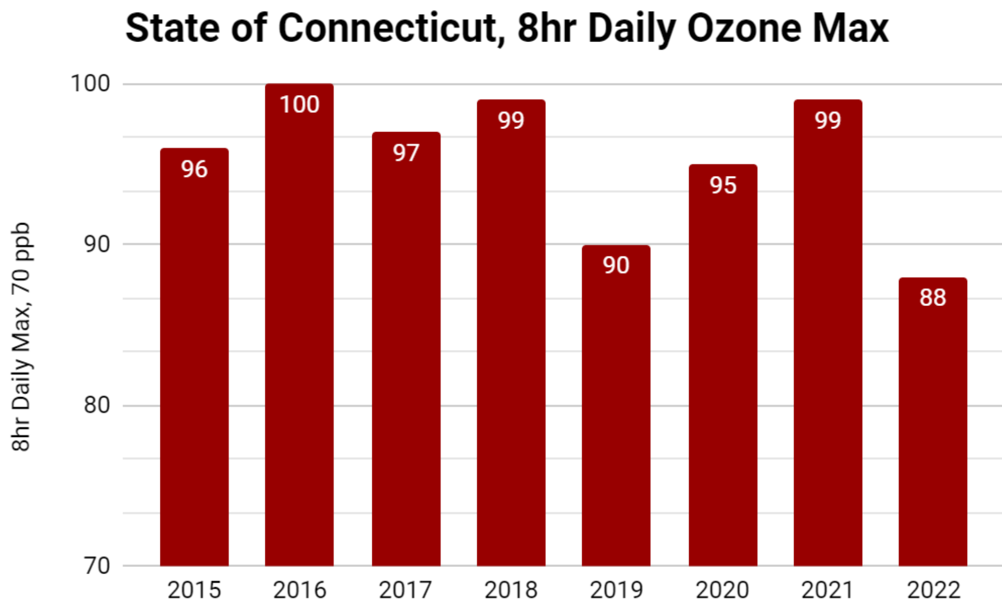
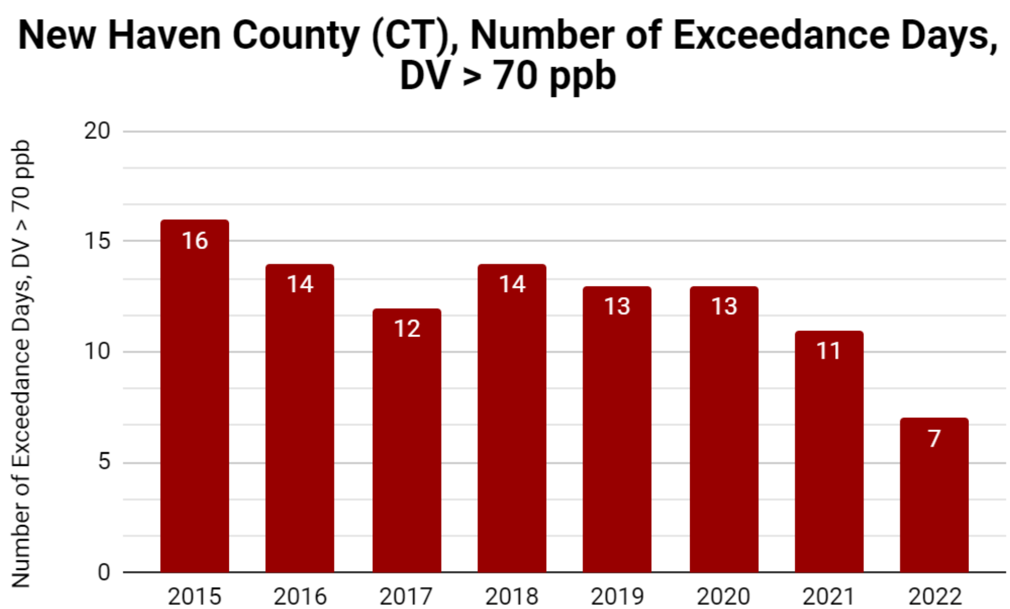
[37] U.S. Census Bureau, *QuickFacts: New Haven city, Connecticut*, (July 1, 2022), https://www.census.gov/quickfacts/newhavencityconnecticut.

[38] EPA, *EJScreen* (last accessed May 4, 2023), https://ejscreen.epa.gov/mapper/. Numbers for New Haven were generated by selecting the city and generating the "Printable Standard Report."

[39] EPA, *Outdoor Air Quality Data, Monitor Values Report* (last accessed April 19, 2023), https://www.epa.gov/outdoor-air-quality-data/monitor-values-report. This data excludes exceptional events.

[40] EPA, *Outdoor Air Quality Data, Air Data - Ozone Exceedances* (last accessed April 19, 2023), https://www.epa.gov/outdoor-air-quality-data/air-data-ozone-exceedances.





As the numbers above demonstrate, Connecticut's nonattainment areas are making halting steps toward meeting the ozone NAAQS, and communities in and surrounding urban areas, such as New Haven and Hartford, are routinely exposed to extremely high ozone concentrations. This ozone exposure has a negative impact on human health, as explained in the following section.

b. Ozone Exposure at Levels Below What Connecticut Residents Regularly Experience Still Has Significant, Adverse Health Impacts

Although Connecticut's air quality has shown some improvements in recent years, ozone continues to harm Connecticut residents even at levels below the current NAAQS. At its most

recent meeting in March, the ozone panel of EPA's Clean Air Scientific Advisory Committee—composed of preeminent national experts on ozone air pollution—voted to recommend tightening the primary health-based ozone standard from its current 70 ppb level to a range of 55-60 ppb.

Exposure to ozone, the main component of smog, has detrimental effects on human health. Even short-term ozone exposure is linked to chronic conditions affecting the respiratory, cardiovascular, reproductive, and central nervous systems, as well as mortality.[41] Respiratory symptoms of ozone exposure include coughing, wheezing, and shortness of breath.[42] Notably, ozone exacerbates asthma and can contribute to new onset asthma.[43] Accordingly, ozone exposure is associated with increased asthma attacks, emergency room visits, hospitalization, and the need for asthma medications.[44]

The health effects of ozone exposure are cumulative, increasing with higher ozone concentrations and increased exposure time.[45] The impacts of ozone exposure on the respiratory system can occur at concentration levels below the 2015 8-hour ozone NAAQS of 70 ppb.[46] In fact, ozone concentrations as low as 60 ppb can cause inflammation and decreased lung function in healthy, exercising adults after 6.6 hours of exposure.[47] Furthermore, studies have observed an association between short-term ozone exposure and hospital admission or emergency department visits at concentrations as low as 31 ppb.[48]

While the health impacts of ozone are ubiquitous, certain populations are at an increased risk of ozone-related health effects. These populations include people with asthma and/or lung disease, children, people over the age of 65, pregnant people, people of color, and outdoor workers.[49] Factors contributing to an individual's risk of ozone-induced health burdens include exposure, susceptibility, access to healthcare, and psychosocial stress.[50] These factors can intersect to place certain individuals at even greater risks. For example, children experience increased exposure to ozone because they are more likely to spend time being active outdoors, and experience increased susceptibility to the health impacts of ozone due to their developing lungs and higher occurrences of respiratory infections than adults.[51]

The pervasive impacts of ozone exposure disproportionately burden communities of color and economically marginalized populations. Higher levels of exposure can be attributed to the historical siting of polluting facilities in marginalized communities as opposed to more affluent, predominantly white neighborhoods.[52] Accordingly, people of color, especially Black individuals, carry a higher asthma burden than white people, and are overrepresented in the nation's ozone

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[41] *See* EPA, *Policy Assessment for the Review of the Ozone National Ambient Air Quality Standards* (EPA-HQ-OAR-2008-0699-0404, Aug. 2014).
[42] *Id*. at 3-27.
[43] *Id*. at 3-28.
[44] *See id*.
[45] *See id*.
[46] EPA, *National Ambient Air Quality Standards for Ozone*, 80 Fed. Reg. 65,292, 65,292 (Oct. 26, 2015).
[47] EPA, *Integrated Science Assessment for Ozone and Related Photochemical Oxidants at IS-1* (2020), https://www.epa.gov/isa/integrated-science-assessment-isa-ozone-and-related-photochemical-oxidants/.
[48] *Id*. at IS-27.
[49] *Id*. at 2-30; EPA, *National Ambient Air Quality Standards for Ozone*, 80 Fed. Reg. 65,292, 65,310 (Oct. 26, 2015).
[50] American Lung Ass'n, *State of the Air 2022, Tracking Air Pollution & Championing Clean Air 25* (2022), https://www.lung.org/getmedia/74b3d3d3-88d1-4335-95d8-c4e47d0282c1/sota-2022/.
[51] *Id*. at 26.
[52] *Id*.

nonattainment areas. Furthermore, people of color are more susceptible to the impacts of air pollution, such as asthma, diabetes, and heart conditions, because they are more likely than white individuals to be living with one or more chronic conditions.[53]

c. Connecticut's Elevated Ozone Levels Demonstrate Clear Adverse Impacts on Environmental Justice Communities

Connecticut is often referred to as the "tailpipe of the nation," given that it continuously bears the burden of out-of-state air pollution from cars and factories in the Midwest–a result of winds blowing pollution eastward.[54] However, pollution created in state also is a significant contributor to Connecticut's nonattainment, and the adverse health impacts of ozone exposure do not affect all Connecticut residents equally.

EPA's EJScreen tool shows that communities in the NY-NJ-CT nonattainment area, which includes the City of New Haven, have high environmental justice index values for ozone, considering both exposure to pollution and socioeconomic indicators. These impacts are reflected in disproportionately poor health outcomes for people of color and those living in poverty.

The environmental justice ("EJ") index for ozone is calculated by combining the environmental factor of ozone concentration with demographic factors, including populations of low-income individuals and people of color residing in a geographic area.[55] In New Haven, the EJ index for ozone is in the 91st percentile compared to the state of Connecticut and the 87th percentile compared to the U.S. This means that only 9% of the state and 13% of the country's population have worse EJ index values for ozone.[56] In Hartford, the EJ index for ozone is in the 70th percentile in the state and 79th percentile in the U.S.[57]

Both populations in New Haven and Hartford are minority majority cities. New Haven's population is 33.9% Black, 30.3% Hispanic or Latino, and 5.2% Asian, with 24.6% of residents living in poverty.[58] In Hartford, 45.5% of the population is Hispanic or Latino, 36.4% is Black, and 2.6% Asian, with 28.4% of the population living in poverty.[59]

The unequal burden of ozone-caused public health impacts in Connecticut is borne out by asthma data. Asthma is one of the primary public health impacts of ozone exposure and affects Black communities at disproportionate rates in the State, as shown by emergency department visits, hospitalizations, and death rates. The data below illustrate that emergency department visits for

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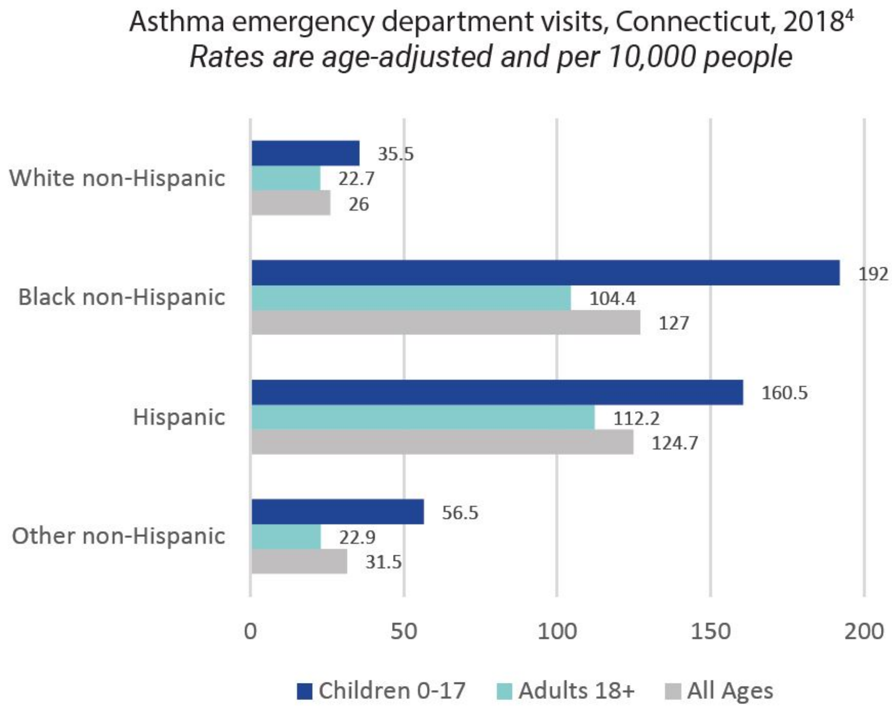
[53] *Id*.
[54] *See* Savitt, Michayla, *Air quality report shows CT still suffers from out-of-state pollution*, CT Mirror, (April 20, 2023), https://ctmirror.org/2023/04/20/ct-air-pollution-ozone-levels-tailpipe-of-the-nation/. *See also* EPA, *What is Interstate Air Pollution Transport?*, (last updated Feb. 17, 2023), https://www.epa.gov/interstate-air-pollution-transport/what-interstate-air-pollution-transport#:~:text=upwind%20emissions%20of%20pollution%20%2D%2D,come%20from%20a%20different%20state.
[55] For EPA's explanation of this indicator, *see* EPA, *EJ and Supplemental Indexes in EJScreen* (last accessed Feb. 13, 2023), https://www.epa.gov/ejscreen/ej-and-supplemental-indexes-ejscreen.
[56] *See* EPA, *EJScreen* (last accessed May 4, 2023), https://ejscreen.epa.gov/mapper/. Numbers for New Haven were generated by selecting the city and generating the "Printable Standard Report."
[57] *Id.*
[58] U.S. Census Bureau, *QuickFacts: New Haven city, Connecticut*, (July 1, 2022), https://www.census.gov/quickfacts/newhavencityconnecticut.
[59] U.S. Census Bureau, *QuickFacts: Hartford city, Connecticut*, (July 1, 2022), https://www.census.gov/quickfacts/hartfordcityconnecticut.

asthma are much more frequent—over five times higher—among Black children aged 2-17 years than white children.[60] In addition, Black Connecticut residents are nearly three times as likely, and Hispanic residents twice as likely, to die from asthma as white residents.[61]



The American Lung Association's 2023 report ranked the NY-NJ-CT-PA area 12th on the list of 25 cities most polluted by ozone, with the Hartford-East Hartford area the 25th listed.[62] In addition, four of Connecticut's counties received an F grade for their ozone levels.[63] According to the American Lung Association, "[b]reathing ozone-polluted air can trigger asthma attacks in both adults and children with asthma, which can land them in the doctor's office or the emergency room," and can even shorten people's lives.[64] The same report also states that warmer temperatures, triggered by climate change, are making ozone more likely to form and harder to clean up in the long-run.[65]

Reducing ozone pollution and NOx emissions, a precursor to ozone pollution, is therefore essential to reducing the unequal public health harms unjustly borne by low-income populations and people of color in Connecticut. As discussed below, adopting the ACC II, ACT, and HDO Rules, which require sales of increasing percentages of zero-emission vehicles, as well as decreasing

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[60] Connecticut Health Foundation, *Health Disparities in Connecticut: Asthma Fact Sheet*, (updated 2020), https://www.cthealth.org/wp-content/uploads/2020/08/Health-disparities-fact-sheet-asthma.pdf.
[61] *Id.*
[62] American Lung Association, State of the Air: Most Polluted Cities, (2023), https://www.lung.org/research/sota/city-rankings/most-polluted-cities.
[63] *Id.*
[64] American Lung Association, "Connecticut's Air Quality Earns Straight Fs for Ozone, Despite Improvements, Finds 2020 'State of the Air' Report" (Apr. 21, 2020), https://www.lung.org/media/press-releases/state-of-the-air-connecticut.
[65] *Id.*

quantities of NOx emissions from internal combustion engines, is critical for improving public health in Connecticut's urban and rural environmental justice communities.

II. Pollution from Vehicles Is a Major Driver of Connecticut's Elevated Ozone Levels

The transportation sector is one of the largest contributors to GHG emissions in the country and continues to drive climate change and related public health concerns. By implementing rules to transition to zero-emission vehicles and cleaner energy, air quality in densely populated metro areas would be improved tremendously. A report from the American Lung Association states that the NY-NJ-CT-PA metro area is the second metro area in the country most likely to benefit from a "transition to electric vehicles between 2020 and 2050.[66]" The benefits are even more significant in counties with higher populations of people of color, such as those in New Haven and Hartford.

Pollution from light-duty, medium-duty, and heavy-duty vehicles is a significant source of NOx emissions—and therefore ozone formation—in Connecticut. These emissions must be reduced to come into attainment with the ozone NAAQS and minimize public health harms. In order to reduce these emissions, Connecticut must promptly adopt and enforce California's ACC II, ACT, and HDO Rules.

Overview: NOx Emissions from Connecticut Vehicles

As of December 2022, there were 30,186 registered electric vehicles in Connecticut, making up only a fraction of the nearly three million light-duty passenger vehicles and trucks registered in the State.[67]

Data, as seen in the figure below, demonstrate that 36.9% of NOx emissions in Connecticut come from light- and heavy-duty vehicles.[68]

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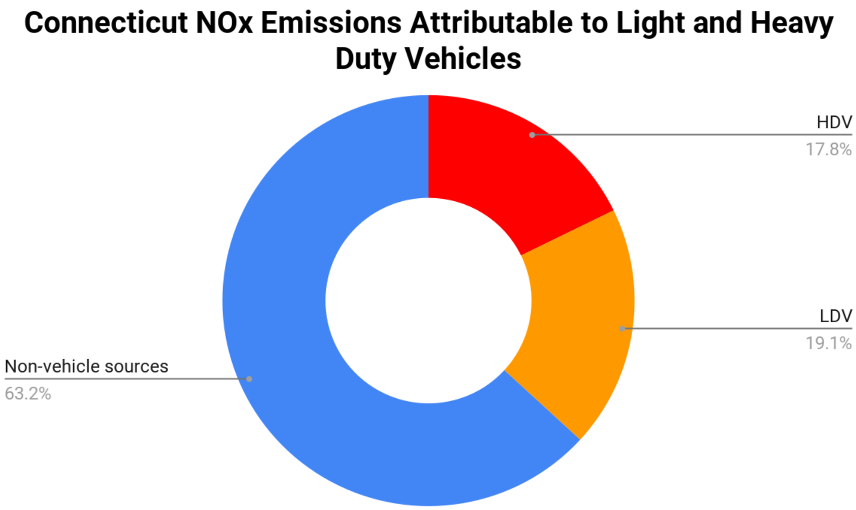
[66] American Lung Association, "New Report: Transition to Zero-Emission Vehicles Would Save More Than 100,000 Lives, Generate $1 Trillion in Public Health Benefits" (Mar. 30, 2022), https://www.lung.org/media/press-releases/new-report-transition-to-zero-emission-vehicles-w.

[67] State of Connecticut Department of Transportation, *NEVI State of Connecticut Plan*, (July 26, 2022), https://portal.ct.gov/-/media/DOT/documents/dsustainabilityandresiliencyunit/CTDOT-Approved-NEVI-Plan-2022-2023.pdf. *See also* Connecticut Department of Motor Vehicle website accessed on July 13, 2022 from https://portal.ct.gov/DMV/News-andPublications/News-and-Publications/Electric-vehicle-stats.

[68] 2020 National Emissions Inventory (NEI) Supporting Data and Summaries, EPA (last accessed April 19, 2023), https://www.epa.gov/air-emissions-inventories/2020-nei-supporting-data-and-summaries. NOx emissions by state and sector were downloaded and compared to determine the relative contribution of NOx emissions from on-road heavy and light duty vehicles.



Given that the *entire* state of Connecticut is currently in nonattainment, it is essential that DEEP take action to ensure that its residents do not continue to suffer the consequences of nonattainment of ozone NAAQS.

b. CAMx Ozone Source Apportionment Technology Modeling by Sonoma Technology Demonstrates That Vehicles Are Major Drivers of High Ozone Levels in Connecticut's Ozone Nonattainment Areas and Environmental Justice Communities

Sierra Club retained Sonoma Technology to model the ozone impacts of light-duty, medium-duty, and heavy-duty vehicles on Connecticut's nonattainment areas and environmental justice communities using the Comprehensive Air Quality Model with Extensions ("CAMx") with Ozone Source Apportionment Technology ("OSAT") for the 2016 ozone season (April to October) in Connecticut.[69] The source apportionment modeling simulations used EPA's 2016v2 (2016fj_6j) modeling platform, which relies on emissions data from the National Emissions Inventory, as well as EPA's 2023 projections platform.[70]

Sonoma Technology found that emissions from on-road vehicles in Connecticut consistently have significant ozone impacts in the State's nonattainment areas. Many of the impacts are far greater than 1% of the 2015 ozone NAAQS: this is particularly notable given that in other regulatory contexts, EPA has found that impacts from *all anthropogenic emissions in an upwind state* to be significant if they exceed 1% of the ozone NAAQS. EPA has considered contributions from all anthropogenic emissions in an upwind state to be significant if they exceed 1% of the ozone NAAQS averaged over a subset of high ozone days during an ozone season.[71] Consequently, results showing that a single class of vehicles on Connecticut's roads alone contributes more than 1% of the ozone

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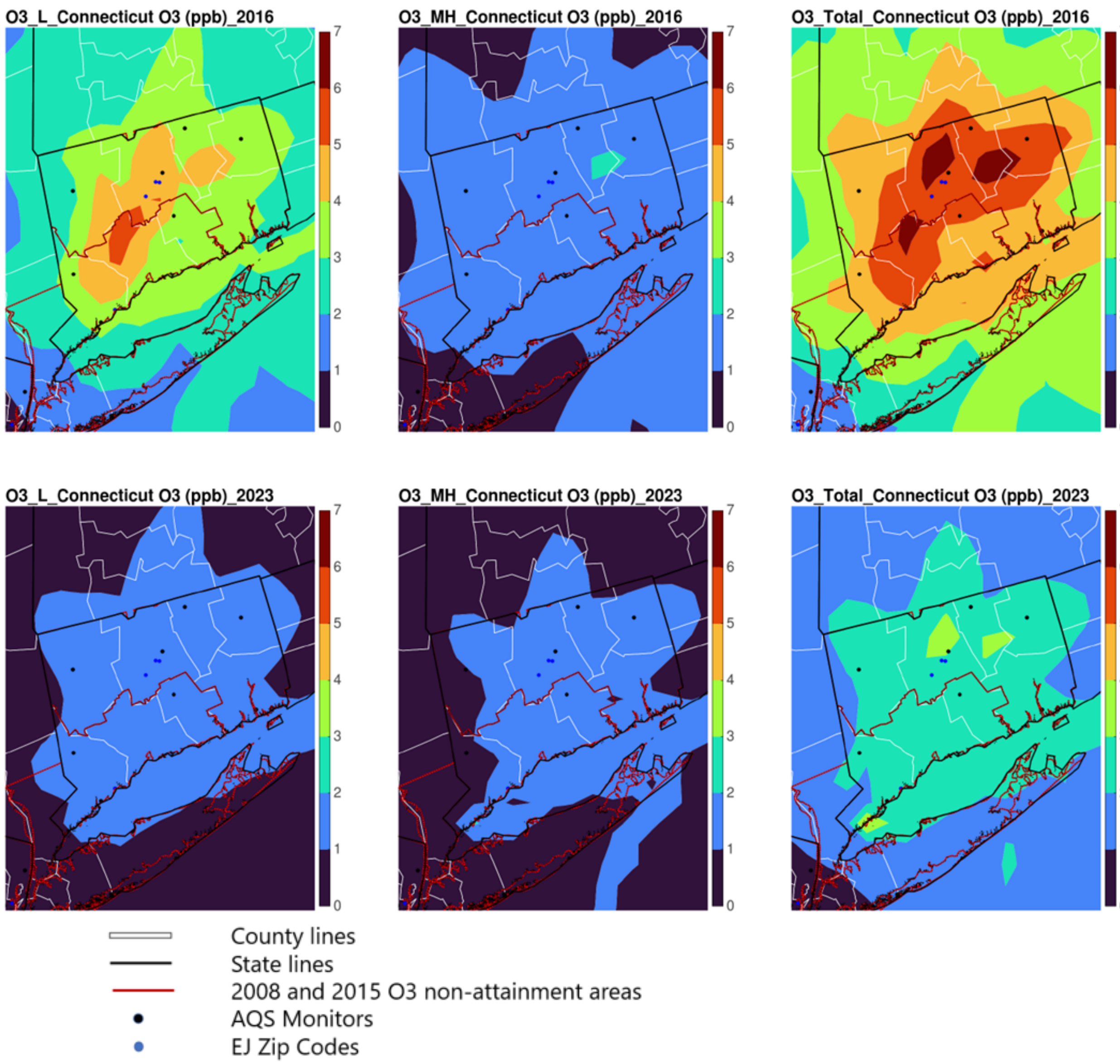
[69] Lynn Alley & Kenneth Craig, Sonoma Technology, *Technical Memorandum Re: Analysis of Air Quality Impacts from Onroad Mobile Sources on Ozone Nonattainment areas in Connecticut, Illinois, Maryland, Michigan, New Jersey, and Pennsylvania* (May 19, 2023).
[70] For an in-depth explanation of the data analysis methods of this report, *see id.* at 1-2, Appendix A.
[71] See, e.g., EPA, Revised Cross-State Air Pollution Rule Update for the 2008 Ozone NAAQS, 86 Fed. Reg. 23054, 23057 (Apr. 30, 2021); EPA, Federal "Good Neighbor Plan" for the 2015 Ozone National Ambient Air Quality Standards, EPA-HQ-OAR-2021-0668, Mar. 2023)

NAAQS on high ozone days are extremely significant. In fact, as discussed below, the highest monitored ozone impacts from vehicles in the Greater Connecticut nonattainment area in 2016 exceeded 5 ppb on nonattainment days.

1. Vehicles in Connecticut Have Significant Ozone Impacts on the State's Nonattainment Areas

On many days in 2016 that exceeded the 2015 ozone NAAQS of 70 ppb, the ozone impacts from vehicles in Connecticut contributed multiple parts per billion of ozone to the atmosphere. The highest combined contribution to ozone from all on-road vehicles in Connecticut was 5.48 ppb, or 7.83% of the 70 ppb ozone NAAQS limit. The collective impact of this pollution is reflected in the following map of ozone impacts on Connecticut generated by Sonoma Technology:



Absolute maximum modeled MDA8 ozone impacts (ppb) due to Connecticut onroad mobile sources during the 2016 ozone season (April to October). "L" denotes LDVs, "MH" denotes MHDVs, and "Total" denotes

the combination of LDVs and MHDVs. 2016 shows base year modeled ozone impacts and 2023 shows projected future year modeled ozone impacts.

Greater Connecticut Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
22-Apr	0.14	0.04	0.18	0.46	0.15	0.61
25-May	1.17	0.50	1.67	0.78	0.31	1.09
26-May	**3.75**	**1.73**	**5.48**	2.95	**1.37**	4.32
27-May	0.29	0.09	0.38	0.69	0.27	0.96
28-May	2.46	0.37	2.83	2.06	0.31	2.37
7-Jun	0.16	0.08	0.24	1.08	0.49	1.57
16-Jun	0.27	0.13	0.40	2.80	1.34	4.14
26-Jun	1.09	0.25	1.34	**3.85**	0.67	**4.52**
6-Jul	2.37	1.01	3.38	1.76	0.76	2.52
15-Jul	1.97	0.92	2.89	2.23	0.83	3.06
16-Jul	0.98	0.40	1.38	2.16	0.46	2.62
17-Jul	0.24	0.06	0.30	3.42	0.54	3.96
21-Jul	0.94	0.43	1.37	1.08	0.36	1.44
22-Jul	1.67	0.59	2.26	1.17	0.41	1.58
25-Jul	1.61	0.70	2.31	1.98	0.86	2.84
28-Jul	1.56	0.66	2.22	1.28	0.54	1.82
5-Aug	2.66	0.98	3.64	2.04	0.75	2.79
25-Aug	0.30	0.13	0.43	1.23	0.58	1.81
8-Sep	0.36	0.13	0.49	1.67	0.75	2.42
14-Sep	0.32	0.13	0.45	0.82	0.36	1.18

Maximum 2016 Modeled Impacts from Connecticut onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in bold.

New York-Northern New Jersey-Long Island, CT Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
22-Apr	0.48	0.15	0.63	0.11	0.04	0.15
12-May	1.67	0.79	2.46	0.63	0.30	0.93
25-May	2.08	0.83	2.91	0.51	0.24	0.75
26-May	2.22	1.11	3.33	0.97	**0.50**	1.47
27-May	0.12	0.03	0.15	0.13	0.07	0.20
28-May	1.74	0.28	2.02	0.34	0.07	0.41
29-May	0.58	0.07	0.65	0.26	0.05	0.31
7-Jun	0.45	0.21	0.66	0.29	0.15	0.44
16-Jun	1.57	0.66	2.23	0.77	0.31	1.08
21-Jun	2.08	0.93	3.01	0.85	0.43	1.28
23-Jun	2.19	1.03	3.22	0.46	0.20	0.66
26-Jun	1.10	0.24	1.34	0.71	0.16	0.87
6-Jul	**2.76**	**1.20**	**3.96**	0.92	0.47	1.39
12-Jul	0.67	0.27	0.94	0.83	0.37	1.20
15-Jul	1.84	0.60	2.44	0.73	0.30	1.03
17-Jul	0.81	0.14	0.95	**1.49**	0.27	**1.76**
18-Jul	0.93	0.38	1.31	0.33	0.17	0.50
21-Jul	1.83	0.72	2.55	0.72	0.36	1.08
22-Jul	1.10	0.36	1.46	0.19	0.07	0.26
11-Aug	0.71	0.27	0.98	0.06	0.03	0.09
12-Aug	1.39	0.44	1.83	0.38	0.14	0.52
13-Aug	0.55	0.10	0.65	0.65	0.11	0.76
24-Aug	0.52	0.25	0.77	0.82	0.41	1.23
31-Aug	0.33	0.13	0.46	0.43	0.20	0.63
8-Sep	0.33	0.13	0.46	0.26	0.10	0.36
14-Sep	0.50	0.19	0.69	0.20	0.09	0.29

Maximum 2016 Modeled Impacts from Connecticut onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in bold.

When projected impacts in 2023 were modeled for the Greater Connecticut nonattainment area, sizable impacts of up to 2.71 ppb from medium- and heavy-duty vehicles are still expected:

Greater Connecticut Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
22-Apr	0.08	0.04	0.12	0.36	0.23	0.59
25-May	0.64	0.53	1.17	0.30	0.27	0.57
26-May	**1.39**	**1.32**	**2.71**	1.10	1.04	2.14
27-May	0.22	0.13	0.35	0.38	0.31	0.69
28-May	0.86	0.26	1.12	0.71	0.22	0.93
7-Jun	0.07	0.06	0.13	0.43	0.40	0.83
16-Jun	0.14	0.12	0.26	1.09	**1.05**	**2.14**
26-Jun	0.38	0.17	0.55	**1.41**	0.50	1.91
6-Jul	0.84	0.84	1.68	0.69	0.61	1.30
15-Jul	0.83	0.77	1.60	0.84	0.65	1.49
16-Jul	0.42	0.28	0.70	0.63	0.30	0.93
17-Jul	0.09	0.04	0.13	1.22	0.40	1.62
21-Jul	0.44	0.35	0.79	0.39	0.27	0.66
22-Jul	0.63	0.45	1.08	0.47	0.36	0.83
25-Jul	0.64	0.54	1.18	0.78	0.67	1.45
28-Jul	0.56	0.49	1.05	0.46	0.40	0.86
5-Aug	1.01	0.76	1.77	0.84	0.64	1.48
25-Aug	0.13	0.11	0.24	0.59	0.56	1.15
8-Sep	0.15	0.11	0.26	0.77	0.69	1.46
14-Sep	0.17	0.15	0.32	0.36	0.33	0.69

Maximum 2023 Projected Modeled Impacts from Connecticut onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in bold.

New York-Northern New Jersey-Long Island, CT Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
22-Apr	0.30	0.18	0.48	0.04	0.05	0.09
12-May	0.58	0.51	1.09	0.29	0.30	0.59
25-May	0.78	0.62	1.40	0.24	0.25	0.49
26-May	0.82	0.80	1.62	**0.61**	**0.58**	**1.19**
27-May	0.10	0.06	0.16	0.07	0.10	0.17
28-May	0.66	0.21	0.87	0.17	0.06	0.23
29-May	0.20	0.05	0.25	0.14	0.05	0.19
7-Jun	0.20	0.19	0.39	0.16	0.17	0.33
16-Jun	0.64	0.54	1.18	0.35	0.31	0.66
21-Jun	0.80	0.72	1.52	0.40	0.44	0.84
23-Jun	**1.03**	**0.95**	**1.98**	0.32	0.30	0.62
26-Jun	0.39	0.17	0.56	0.28	0.13	0.41
6-Jul	1.03	0.90	1.93	0.36	0.38	0.74
12-Jul	0.27	0.21	0.48	0.39	0.37	0.76
15-Jul	0.54	0.34	0.88	0.27	0.24	0.51
17-Jul	0.28	0.10	0.38	0.51	0.19	0.70
18-Jul	0.44	0.36	0.80	0.16	0.16	0.32
21-Jul	0.68	0.64	1.32	0.28	0.28	0.56
22-Jul	0.49	0.32	0.81	0.10	0.10	0.20
11-Aug	0.54	0.40	0.94	0.04	0.04	0.08
12-Aug	0.63	0.40	1.03	0.18	0.16	0.34
13-Aug	0.25	0.10	0.35	0.30	0.10	0.40
24-Aug	0.23	0.22	0.45	0.35	0.37	0.72
31-Aug	0.17	0.16	0.33	0.21	0.20	0.41
8-Sep	0.18	0.14	0.32	0.17	0.14	0.31
14-Sep	0.26	0.21	0.47	0.11	0.11	0.22

Maximum 2023 Projected Modeled Impacts from Connecticut onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in bold.

As these data reflect, on the majority of ozone nonattainment days, the maximum ozone impact from on-road vehicles in Connecticut has exceeded 0.5% of the ozone NAAQS, and often has exceeded 1%—which, again, EPA considers a "significant contribution" triggering statewide NOx reductions in other regulatory contexts. Indeed, on-road transportation is one of the most significant single in-state contributors to state wide ozone levels that we are aware of. Therefore, adopting all of California's vehicle rules—ACC II, ACT, and HDO—would likely be the single strongest measure for reducing ozone pollution across Connecticut.

III. Connecticut Must Reduce NOx Emissions by Adopting the ACC II, ACT, and HDO Rules

In order to comply with binding Connecticut law, protect public health, and reduce climate-changing emissions, Connecticut should adopt the ACC II, ACT, and HDO Rules, which reduce pollution from light-, medium-, and heavy-duty vehicles.

1. Authority to Adopt Light-Duty Vehicles Rule: ACC II

The ACC II Rule requires manufacturers to sell an increasing percentage of new zero-emission cars and light-duty trucks starting in model year 2027, with 100% of these sales being zero-emission vehicles in 2035.[72] Connecticut's 2004 Act Concerning Clean Cars states:

> [T]he Commissioner of Environmental Protection shall adopt regulations . . . to implement the light duty motor vehicle emission standards of the state of California, and shall amend such regulations from time to time, in accordance with changes in said standards. Such regulations shall be applicable to motor vehicles with a model year 2008 and later.[73]

In order to fully comply with this binding statutory requirement, DEEP must achieve its plan of promulgating an ACC II regulation in 2023,[74] and implement the zero-emission light-duty vehicle sales requirements mandated by the ACC II Rule. This is consistent with a recent explanation of light-duty vehicle regulations in the Office of Legislative Research's summary of the Connecticut Clean Air Act: "State law already *requires* DEEP to adopt regulations implementing California's emissions standards for light-duty motor vehicles (e.g., passenger cars, SUVs, pickup trucks) *and keep them current* with changes California makes."[75] DEEP should comply with this statutory mandate by adopting the ACC II Rule in 2023.

2. Authority to Adopt Medium- and Heavy-Duty Vehicles Rules: ACT and HDO

The recently enacted Connecticut Clean Air Act provides DEEP with explicit statutory authority to adopt California's rules pertaining to medium- and heavy-duty vehicles, stating: "The Commissioner of Energy and Environmental Protection may adopt regulations . . . to implement the medium and heavy-duty motor vehicle standards of the state of California."[76]

This law also authorizes DEEP to provide vouchers for zero-emission vehicles and associated charging infrastructure, which will make it more affordable for Connecticut's residents to purchase the zero-emission vehicles that will be sold in the state pursuant to the ACC II and ACT Rules.[77]

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[72] California Air Resources Board, *Proposed Advanced Clean Cars II (ACC II) Regulations*, https://ww2.arb.ca.gov/rulemaking/2022/advanced-clean-cars-ii.

[73] 2004 Conn. Pub. Acts 04-84(a).

[74] *Id.*

[75] Office of Legislative Research, Public Act Summary: Conn. Pub. Act 22-25, https://www.cga.ct.gov/2022/SUM/PDF/2022SUM00025-R02SB-00004-SUM.PDF (emphases added).

[76] 2022 Conn. Pub. Acts 22-25 § 15(c).

[77] *Id.* § 14.

The ACT Rule would clean Connecticut's air by requiring increasing reductions in GHG emissions from medium- and heavy-duty vehicles from model year 2024 through model year 2035.[78] Meanwhile, the HDO Rule is an important complementary measure to adopt in tandem with regulations implementing the ACT Rule. While the ACT Rule does not require sales of 100% zero-emission trucks right away, the HDO Rule would ensure that the diesel trucks that are still sold and purchased in the coming years are cleaner and safer for public health, and that the cost of these trucks reflect the actual societal cost of the dangerous air pollutants they emit.[79] More specifically, the HDO Rule sets standards for the acceptable levels of certain harmful air pollutants—including NOx, non-methane hydrocarbons, carbon dioxide, and particulate matter—emitted by heavy-duty trucks.[80] These standards grow stricter over time, requiring trucks' NOx emissions to decrease by 75% in 2024 and by 90% beginning in 2027.[81]

The ACT Rule, as promulgated by the California Air Resources Board, has a two-year lead time that is carefully calibrated to the rapidly progressing technology of medium- and heavy-duty electric vehicles. Numerous other states, including California, Colorado, New York, New Jersey, Washington, Oregon, Massachusetts and Vermont, have either already adopted, or are in the process of adopting, the ACT Rule, reflecting their collective judgment that there is no need to delay adoption of the ACT Rule. Connecticut can take advantage of the many available federal funds that can accelerate the state's adoption of charging infrastructure and accelerate the acquisition of electric vehicles themselves. These federal funding sources include billions of dollars in grants for electric vehicle purchases under the Infrastructure Investment & Jobs Act's ("IIJA") Low-No NOx, Competitive Bus & Bus Facilities, and Congestion Mitigation and Air Quality grant programs, as well as grants for charging infrastructure under the National Electric Vehicle Infrastructure ("NEVI") and Charging & Fueling Infrastructure grant programs.[82]

3. Adopting the ACC II, ACT, and HDO Rules Would Significantly Reduce Connecticut's NOx Emissions and Ozone Levels

Connecticut can dramatically reduce NOx emissions—and ozone pollution that forms from the interaction of NOx emissions with other pollutants in the atmosphere—by adopting the ACC II, ACT, and HDO Rules.

Sierra Club used EV-REDI, a transportation analysis tool developed by Synapse Energy Economics, to model the impacts of Connecticut adopting the ZEV program of the ACC II Rule, as compared to a business-as-usual ("BAU") scenario where ZEV sales shares meet state-specific projections by Rhodium in the central scenario of its 2022 Taking Stock and IRA baseline.[83]

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[78] ACT Rule § 1963.1(b). The ACT rule's requirements vary for different weight classes of vehicles; several classes of trucks must attain 75% zero-emission sales by model year 2035, while others, like tractors, are required to reach 40% zero-emission sales by model year 2035. *Id.*

[79] California Air Resources Board, *Heavy-Duty Omnibus Regulation*, https://ww2.arb.ca.gov/rulemaking/2020/hdomnibuslownox; California Air Resources Board, *Heavy-Duty Low NOx*, https://ww2.arb.ca.gov/our-work/programs/heavy-duty-low-nox.

[80] HDO § 1956.8(A)(2)(D).

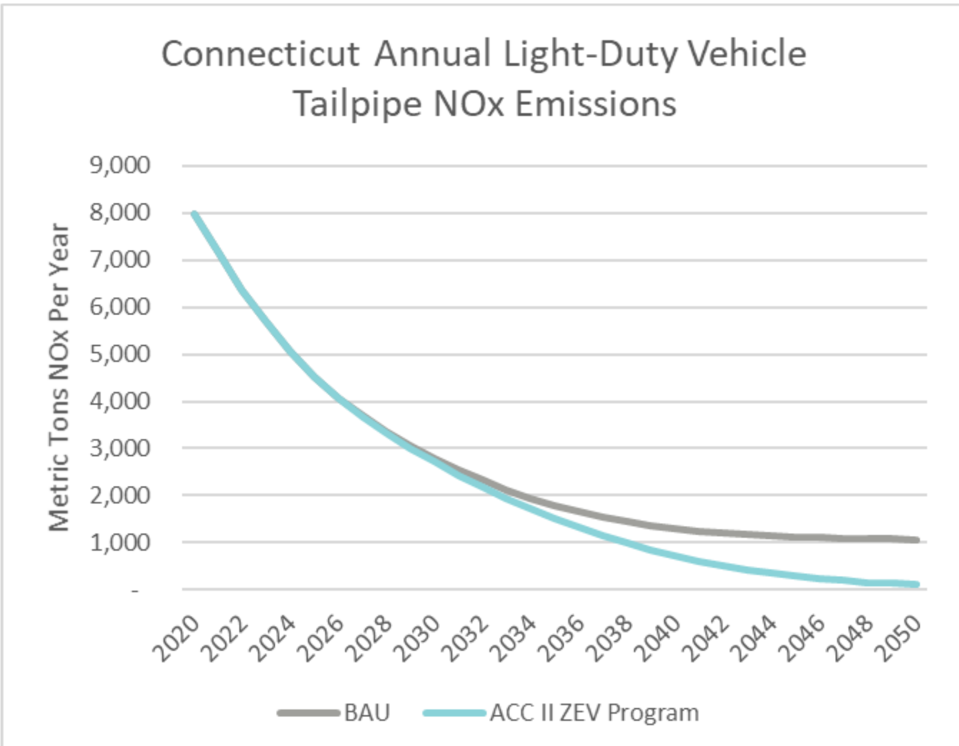
[81] California Air Resources Board, *Heavy-Duty Omnibus Regulation*, https://ww2.arb.ca.gov/rulemaking/2020/hdomnibuslownox; California Air Resources Board, *Heavy-Duty Low NOx*, https://ww2.arb.ca.gov/our-work/programs/heavy-duty-low-nox.

[82] *See* Federal Transit Administration, "FTA Program Fact Sheets under the Bipartisan Infrastructure Law," https://www.transit.dot.gov/funding/grants/fta-program-fact-sheets-under-bipartisan-infrastructure-law.

[83] Analysis of the ZEV component of ACC II by Sierra Club using EV-REDI, a transportation analysis tool developed by Synapse Energy Economics. In this case, EV-REDI takes inputs of annual EV sales percentage of new light-duty

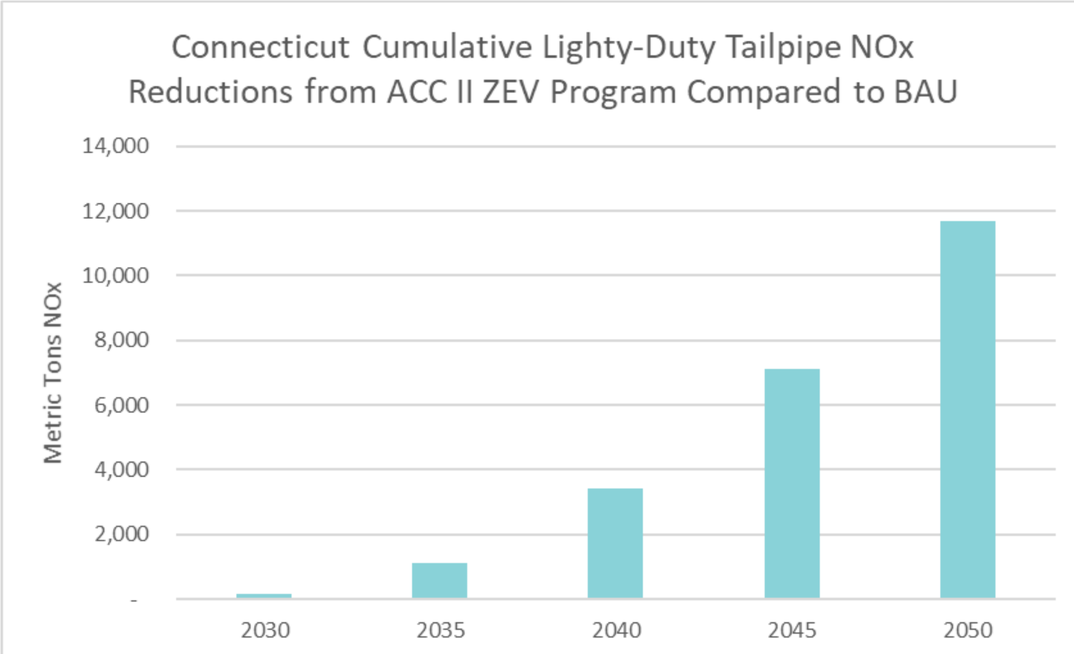
i. ACC II Adoption Projections

As illustrated in the graph below, Connecticut's adoption of ACC II is expected to result in a 98% reduction in the state's light-duty vehicle tailpipe NOx emissions by 2050, relative to 2022 levels. This is higher than the expected 83% reduction in NOx emissions under the business-as-usual scenario. Under business as usual, a transition toward zero-emission vehicles is still predicted, but it would take place at a slower pace.



With these annual savings, Connecticut could cumulatively avoid emissions of nearly 1,100 metric tons of NOx by the ACC II program's end in 2035. By 2050, this quantity of avoided emissions increases tenfold, with cumulative NOx reductions at over 11,600 metric tons.

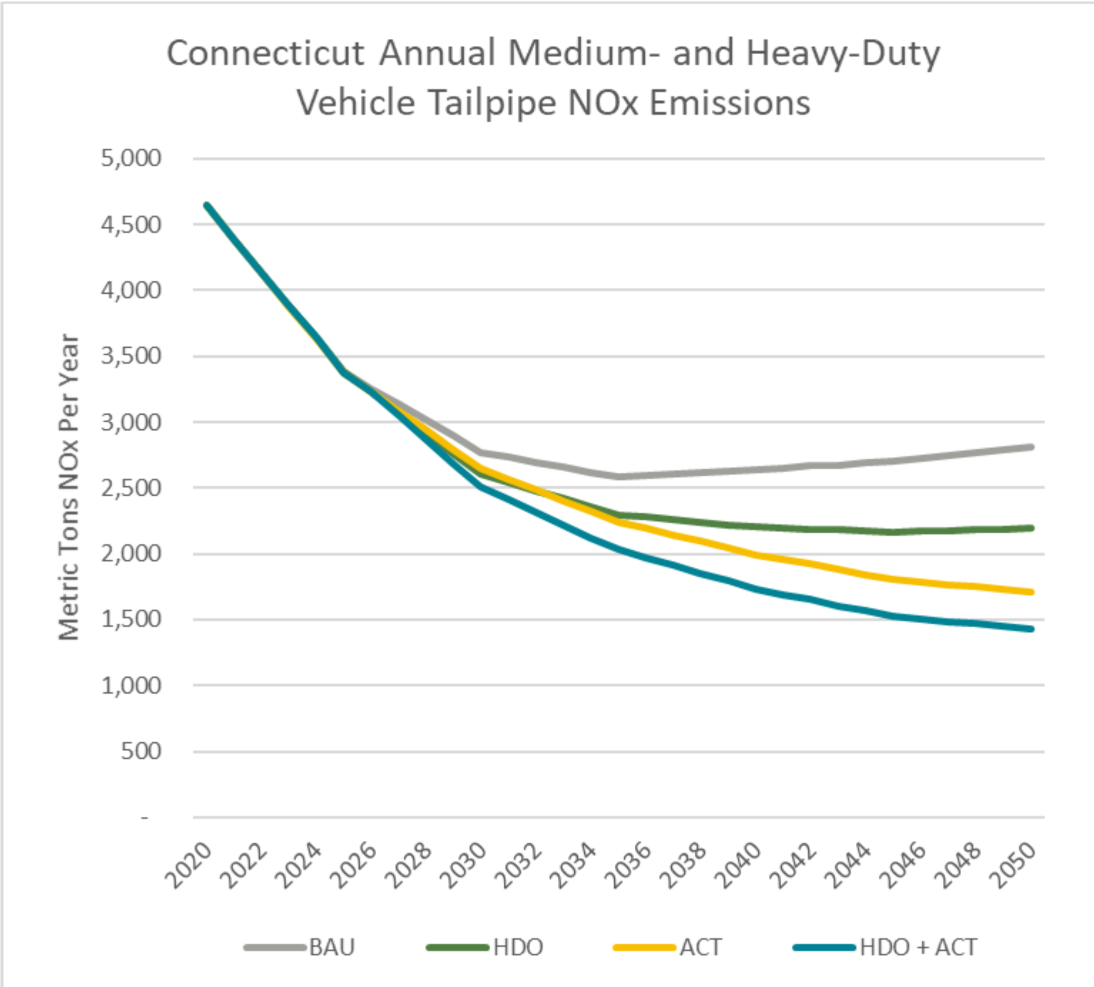
vehicles, and the allowed split between BEVs and PHEVs, and uses state-specific vehicle turnover and VMT data to quantify the impacts on emissions and other metrics. This analysis assumes that in the ACC II scenario, the state's EV sales share matches that of the BAU scenario between historical data from 2022 and the rule's onset in model year 2027, manufacturers use no compliance flexibilities, and that Class 2b trucks are credited under the ACT regulation rather than ACC II. The BAU scenario models the state reaching the state-specific EV sales shares projected by Rhodium Group in the central scenario of its 2022 Taking Stock + IRA baseline in 2025, 2030, and 2035, with interpolation in between, and with EV sales share held constant at 2035 levels through 2050. https://climatedeck.rhg.com/



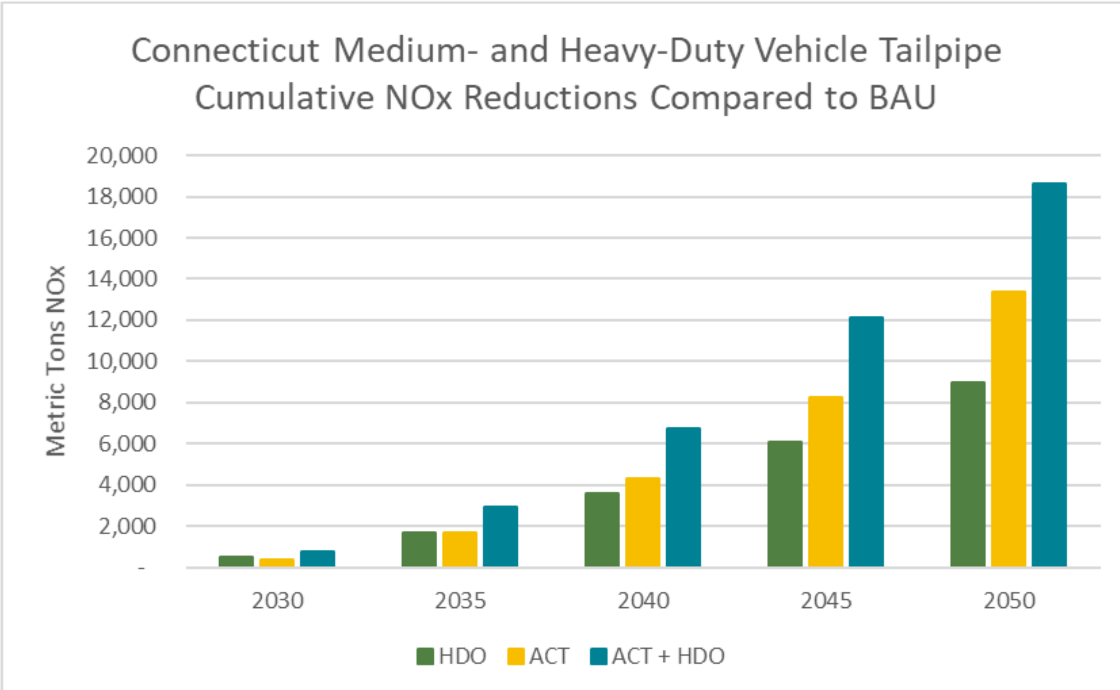
ii. ACT and HDO Adoption Projections

Modeling of the anticipated impacts of adopting the ACT and HDO rules shows that these rules are calculated to markedly decrease NOx emissions statewide from 2030 through 2050. The International Council on Clean Transportation commissioned Sonoma Technology to model the impacts of Connecticut adopting the ACT and HDO rules, as compared to a business-as-usual scenario reflecting federal programs that were in place as of year-end 2021.[84] The graph below shows that adopting only HDO could reduce the tailpipe NOx emissions by 47% below 2022 levels by 2050, while adopting only ACT could result in reductions of 59%. Adopting both programs could reduce Connecticut's medium- and heavy-duty NOx emissions by 65% below 2022 levels in 2050. These scenarios are compared to a business as usual scenario, where NOx emissions are only reduced by 32% in the same time period.

[84] Data from the International Council on Clean Transportation and Sonoma Technology, Inc., converted to metric tons. *See* Benefits of Adopting California Medium- and Heavy-Duty Vehicle Regulations, ICCT. Data updated August 30, 2022. As noted by the study's authors, these figures include tank-to-wheel NOx emissions from all medium- and heavy-duty vehicles "following California's approach to estimating in-use fleet penetration under the ACT program without adjustments to account for vehicles purchased out-of-state, ZEVs that may migrate out-of-state over time, or ZEVs that would have been produced to meet other requirements like the federal GHG Phase II standards." These policy scenarios are compared to a business-as-usual scenario reflecting Federal programs as of the end of 2021, and non-implementation of the GHG Phase 2 trailer requirements, which were under litigation.



By adopting HDO, Connecticut could see cumulative NOx emissions reductions from its medium- and heavy-duty fleet reach nearly 9,000 metric tons by 2050. With ACT, the state could see over 13,300 metric tons of NOx emissions. If Connecticut adopts both rules, the state could benefit from cumulative NOx emissions reductions of over 18,600 metric tons by 2050.



These graphs illustrate the importance of reducing NOx emissions from medium- and heavy-duty vehicles by adopting both the ACT and HDO Rules. Given that the HDO Rule is directly targeted at reducing NOx emissions, this is an especially powerful tool to add to Connecticut's arsenal of clean transportation policies.

4. Connecticut Should Codify Its Adoption of the ACC II, ACT, and HDO Rules in Its Ozone Nonattainment State Implementation Plans

Because adopting California's vehicle rules would reduce NOx emissions and ozone levels in Connecticut, this policy should be designated as a control measure to ensure reasonable further progress ("RFP") to compliance with ozone standards, and potentially a reasonably available control measure ("RACM"), in a future Connecticut SIP.

In areas that are designated as moderate nonattainment under the Clean Air Act, states are required to provide for "reasonable further progress," which means measures that would reduce states' emissions of volatile organic compounds—another ozone precursor—by at least 15%.[85] EPA has clarified that measures to reduce NOx emissions can also count toward this 15% requirement.[86] California has also listed its vehicle rules as proposed measures for reducing NOx emissions in its 2022 ozone nonattainment SIP.[87]

Connecticut may also conclude that adopting the ACC II, ACT, and HDO Rules meets the definition of RACM for the purpose of future SIPs. The Clean Air Act requires nonattainment SIPs

[85] 42 U.S.C. § 7511a(b)(1)(A).
[86] EPA, Guidance on Issues Related to 15 Percent Rate-of-Progress Plans (Aug. 23, 1993), https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/19930823_shapiro_15pct_rop_guidance.pdf.
[87] *See* California Air Resources Board, *2022 State Strategy for the State Implementation Plan* (Sept. 22, 2022), https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf.

to "provide for the implementation of all reasonably available control measures [RACM] as expeditiously as practicable."[88] There are various criteria for categorizing a measure as a RACM:

> "RACM is defined by the EPA as any potential control measure for application to point, area, on-road and non-road emission source categories that meets the following criteria:
> • The control measure is technologically feasible
> • The control measure is economically feasible
> • The control measure does not cause "substantial widespread and long-term adverse impacts"
> • The control measure is not "absurd, unenforceable, or impracticable"
> • The control measure can advance the attainment date by at least one year."[89]

In order to pave the way toward redesignation to attainment for the ozone NAAQS, Connecticut should adopt the ACC II, ACT, and HDO Rules. Connecticut cannot be redesignated to attainment unless it can demonstrate that its "improvement in air quality is due to permanent and enforceable reductions in emissions resulting from implementation of the applicable implementation plan and applicable Federal air pollutant control regulations and other permanent and enforceable reductions."[90] Adopting and implementing these vehicle rules would lead to significant, sustained reductions in NOx emissions that would support future efforts to redesignate the Greater Connecticut and NY-NJ-CT areas to attainment.

5. Adopting the ACC II, ACT, and HDO Rules Would Substantially Improve Public Health Outcomes Across the State

Timely adoption of the ACC II, ACT, and HDO Rules will have long-lasting positive impacts on the health of Connecticut residents. An April 2023 report from Energy Innovation Policy & Technology calculates that, from adopting the *ACC II rule alone*, all Section 177 states[91] will experience the following tangible public health benefits cumulatively by 2050:

- 161,000 Avoided Asthma Attacks
- 574,000 Avoided Lost Workdays
- 5,040 Avoided Premature deaths
- 242,000 Avoided Respiratory Symptoms and Bronchitis
- 6,770 Avoided Nonfatal Heart Attacks
- 3,020 Avoided Hospital Admissions
- 2,660 Avoided Respiratory ER Visits

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[88] 42 U.S.C. § 7502(c)(1).

[89] *See, e.g.*, Approval and Promulgation of Implementation Plans; New York Reasonably Available Control Technology and Reasonably Available Control Measures, 74 Fed. Reg. 42,813, 42,817-42,818, https://www.govinfo.gov/content/pkg/FR-2009-08-25/pdf/E9-20394.pdf.

[90] 42 U.S.C. § 7407(d)(3)(E)(iii).

[91] The term "Section 177 states" refers to states that have opted to follow California's regulations concerning vehicle emissions, which is authorized under Section 177 of the Clean Air Act. *See* 42 U.S. Code § 7507. While the above projections include about a dozen other states in addition to Connecticut, this still illustrates the tangible public health benefits that would accompany adoption of the ACC II Rule in Connecticut. The projected benefits would be even greater if impacts of the ACT and HDO Rules were taken into account. This report was published in April 2023 and, at the time, included Connecticut, Delaware, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Pennsylvania, Rhode Island, Vermont, Washington, and California.

- 3,560,000 Avoided Minor Restricted Activity Days[92]

Adopting the ACT and HDO medium- and heavy-duty vehicle rules would further reduce air pollution that is harmful to public health. Decreasing emissions of NOx and particulate matter from medium- and heavy-duty vehicles' diesel exhaust is expected to reduce the prevalence of asthma, lung disease, and cancer.[93] This public health improvement would be especially pronounced in communities of color and low-income communities, which tend to be disproportionately impacted by many forms of environmental pollution, as illustrated by the much higher rates of asthma experienced in communities of color in Connecticut.[94]

6. Adopting the ACC II, ACT, and HDO Rules Is Critical to Complying with Connecticut's Climate Law

Requiring sales of cleaner light-duty, medium-duty, and heavy-duty vehicles is a key strategy for complying with not only the federal Clean Air Act's ozone NAAQS, but also Connecticut's Act Concerning Climate Change Mitigation. This law sets forth an ambitious requirement of reducing statewide GHG emissions 45% below 2001 levels by January 1, 2030—and subsequently reducing emissions 80% below 2001 levels by 2050.[95] This legally binding target is an ambitious goal, and the state must use every measure in its toolkit to meet it.

Reducing GHG emissions from on-road vehicles is a critical component of meeting the Climate Change Mitigation law's ambitious requirements. In Connecticut, as of 2021, the transportation sector was the single largest source of the state's GHG emissions, "twice as high as residential emissions," and emissions from that sector had not decreased since the 1990s.[96] According to the most recent GHG emissions inventory, a striking 40% of Connecticut's total emissions emanate from the transportation sector.[97] In that inventory, DEEP summarized the importance of requiring increased adoption of electric vehicles—which is exactly the purpose of the ACC II, ACT, and HDO Rules:

> The Governor's Council on Climate Change (GC3), in 2018 and 2021 reports, estimated that for Connecticut to reach its 2030 emissions target, roughly half a million light-duty electric vehicles (EVs) must replace internal combustion vehicles. In 2021, approximately 78,000 EVs, plug-in hybrids, or hybrid vehicles were registered in Connecticut. Compared to the 2.5 million gasoline-powered light duty vehicles in service, EVs are still relatively rare.[98]

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[92] Energy Innovation Policy & Technology LLC, "Nationwide Impacts Of California's Advanced Clean Cars II Rule" (April 9, 2023), https://energyinnovation.org/publication/nationwide-impacts-of-californias-advanced-clean-cars-ii-rule/.

[93] *See* Ghassan B Hamra, et al., "Lung Cancer and Exposure to Nitrogen Dioxide and Traffic: A Systematic Review and Meta-Analysis," Environmental Health Perspectives (Apr. 14, 2015), https://pubmed.ncbi.nlm.nih.gov/25870974/; Małgorzata Kowalska, et al., "Effect of NOx and NO2 Concentration Increase in Ambient Air to Daily Bronchitis and Asthma Exacerbation, Silesian Voivodeship in Poland," International Journal of Environmental Research and Public Health (Jan. 24, 2020), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7037218/; *see also* California Air Resources Board, *Overview: Diesel Exhaust & Health*, https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health.

[94] *See* Section I.b.

[95] 2022 Conn. Pub. Acts 22-5(a).

[96] DEEP, *1990–2021 Connecticut Greenhouse Gas Emissions Inventory* at 9, *supra* note 44.

[97] *Id.* at 11.

[98] *Id.*

In the inventory DEEP explicitly recognized the need to achieve its emission reductions from vehicles by adopting the ACC II, ACT, and HDO Rules *this year*.[99]

Adopting the ACT and HDO Rules would be consistent with a multi-state Memorandum of Understanding on Multi-State Zero Emission Medium- and Heavy-Duty Vehicles ("MOU") that Connecticut joined on July 10, 2020.[100] Through this MOU, Connecticut "agree[d] to strive to make sales of all new medium- and heavy-duty vehicles in our jurisdictions zero emission vehicles by no later than 2050," and agreed that, "[i]n order to ensure adequate progress toward the 2050 goal, the Signatory States will strive to make at least 30 percent of all new medium- and heavy-duty vehicle sales in our jurisdictions zero emission vehicles by no later than 2030."[101]

More broadly, by adopting these rules, Connecticut will contribute to country-wide reductions in GHG emissions by assisting in precipitating a national shift toward electric trucks. A number of states have already adopted some combination of the ACC II, ACT, and HDO Rules, including Maine, Massachusetts, New Jersey, New York, Oregon, Washington, and Vermont.[102] If Connecticut adopts these rules, manufacturers will receive a stronger message that demand for electric cars and trucks is rising. As more and more states adopt these vehicle rules, manufacturers will receive a stronger incentive to shift toward producing only electric trucks.

IV. Conclusion: Connecticut Should Adopt the ACC II, ACT, and HDO Rules Without Delay In 2023

Adoption of the ACC II, ACT, and HDO Rules in 2023 would bring significant health benefits to Connecticut residents and would represent a critical step in protecting environmental justice communities and all Connecticut residents from pollution and addressing the existential threat of climate change. As discussed at length above, together these rules will deliver enormous public health benefits and lasting reductions in greenhouse gas emissions, bringing the state closer to its climate goals.

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[99] *Id.* at 23.
[100] *Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding ["MOU"]*, https://www.nescaum.org/documents/mhdv-zev-mou-20220329.pdf.
[101] *Id.*
[102] *See* National Caucus of Environmental Legislators, "What California's New Advanced Clean Car Rule Means for Other States" (Jan. 10, 2023), https://www.ncelenviro.org/articles/what-californias-new-advanced-clean-car-rule-means-for-other-states/#:~:text=Six%20states%20(Massachusetts%2C%20New%20Jersey,in%20adopting%20the%20ACT%20rule; Sierra Club New Jersey Chapter, "Advocates Urge New Jersey to Catch up to Ten Other States & Adopt the Advanced Clean Cars II Standards This Year" (Mar. 13, 2023), https://www.sierraclub.org/new-jersey/blog/2023/03/advocates-urge-new-jersey-catch-ten-other-states-adopt-advanced-clean-cars.

May 19, 2023 STI-1923042-TM

To: Josh Stebbins, Sierra Club

From: Lynn Alley and Kenneth Craig, Sonoma Technology

Re: Analysis of Air Quality Impacts from Onroad Mobile Sources on Ozone Nonattainment areas in Connecticut, Illinois, Maryland, Michigan, New Jersey, and Pennsylvania

Introduction and Summary

Sonoma Technology performed source apportionment modeling using the Comprehensive Air Quality Model with Extensions (CAMx) with Ozone Source Apportionment Technology (OSAT) to support the Sierra Club in evaluating ozone impacts from onroad mobile sources and other emission sources on downwind receptors in nonattainment areas. The source apportionment modeling was conducted for the 2016 ozone season (April to October) for a domain covering the continental United States at 12-km spatial resolution, and results were compiled into a database with an online dashboard application that can be used for data mining and analysis. CAMx OSAT simulations were also conducted for the 2023 future year using a projection of 2023 future year emissions.[1]

The source apportionment modeling simulations relied on the U.S. Environmental Protection Agency (EPA) 2016v2 (2016fj_16j) modeling platform, which draws on emissions data from the EPA National Emissions Inventory and data developed by the National Emissions Inventory Collaborative.[2] EPA also developed emission inventories for the 2023 future year (2023fj_16j) to project the 2016 base year emissions into 2023. The EPA modeling platform tends to underpredict maximum daily average 8-hr (MDA8) ozone concentrations for days when the MDA8 ozone is greater than or equal to 60 ppb. Modeling results for the monitoring sites included in this report generally follow this trend. Overall, EPA found that “the ozone model performance results for the CAMx 2016fj (2016v2) simulation are within or close to the ranges found in other recent peer-reviewed applications” and that “the model performance results demonstrate the scientific credibility of the 2016v2 modeling platform” (U.S. Environmental Protection Agency, 2022b).

Biases in the modeled ozone concentrations can contribute to uncertainty in the source apportionment contribution results. To help mitigate this uncertainty, the source apportionment modeling results are used in a “relative” sense rather than an “absolute” sense where possible. For

[1] Future year ozone is modeled using emissions that have been projected to the future year, but using meteorology, boundary conditions, and other inputs representative of the 2016 base year.

[2] The National Emissions Inventory Collaborative is a partnership between state emissions inventory staff, multi-jurisdictional organizations, federal land managers, EPA, and others to develop a North American air pollution emissions modeling platform for use in air quality planning.

this report, relative source contributions for the 2016 base year were calculated based on a daily 8-hr average basis by multiplying the absolute modeled source contribution by the ratio of the monitored concentration and the total modeled ozone value. For the future year source contributions, the ratio of the total modeled MDA8 ozone concentration between 2023 and 2016 was used to estimate projected future year (2023) observed ozone concentrations, and this projected observed ozone was used to apportion the modeled ozone. These approaches have been used in past ozone source apportionment modeling analyses (e.g., Craig et al., 2020) and are similar to methods used by EPA to calculate ozone source contributions from a photochemical grid model (U.S. Environmental Protection Agency, 2022b). Anchoring the modeled apportionment results to ambient monitoring data can help mitigate uncertainty associated with imperfect model performance (Foley et al., 2015; Jones et al., 2005). The onroad mobile source ozone source apportionment results in this report should be considered indicative of the types of ozone impacts that can be expected from these mobile sources. Additional details on the models, data, and methods used can be found in **Appendix A**.

The results from this ozone source apportionment modeling were used to analyze impacts of emissions from onroad mobile sources (light duty vehicles [LDV], medium and heavy duty vehicles [MHDV], and the impacts of these two mobile source sectors combined) in Connecticut, Illinois, Maryland, Michigan, New Jersey, and Pennsylvania on air quality monitoring station (AQS) locations and in environmental justice (EJ) zip codes in state nonattainment areas. Maximum modeled contributions are shown on days when the monitored MDA8 ozone concentration exceeded the 2015 ozone standard (70 ppb) in areas that were in nonattainment for either the 2008 National Ambient Air Quality Standards (NAAQS) and/or the 2015 NAAQS.

In summary, the modeling results showed that on numerous nonattainment days in 2016, emissions from onroad mobile sources in each state (CT, IL, MD, MI, NJ, PA) resulted in impacts of greater than 1% of the ozone NAAQS (i.e., ozone impacts exceeding 0.70 ppb) at AQS monitoring locations and EJ zip code receptors within ozone nonattainment areas. The maximum modeled 8-hour ozone impact occurred in Detroit, Michigan on July 27, 2016 due to the total of all Michigan onroad mobile source emissions: The 2016 base year maximum ozone modeled impact at a nonattainment area monitor was 14.36 ppb and the 2023 future year maximum ozone modeled impact was 10.02 ppb. For EJ zip codes in Detroit, the 2016 base year maximum ozone modeled impact was 8.99 ppb and the 2023 future year maximum ozone modeled impact was 6.79 ppb.

Significant impacts occurred for the 2016 base emissions year and the 2023 projected future emissions year for all state nonattainment areas analyzed in this report. The substantial decrease in projected ozone contributions in 2023 is tied to the ~50% reduction in onroad mobile source NO_x emissions in the EPA modeling platform between 2016 and 2023 (see **Appendix A** for details). Despite this large projected decrease in NOx emissions, modeled impacts from onroad mobile sources remain significant in the 2023 projections.

Ozone Nonattainment Areas

For each state of interest—Connecticut, Illinois, Maryland, Michigan, New Jersey, and Pennsylvania—modeled contributions from onroad mobile sources (light duty vehicles [LDV], medium and heavy duty vehicles [MHDV], and the impacts of these two mobile source sectors combined) are presented. The LDV source tag includes motorcycles, passenger cars and trucks, and light commercial trucks (MOVES3 model source types 11, 21, 31, and 32). The MHDV source tag includes short- and long-haul single unit and combination trucks, refuse trucks, buses, and motorhomes (MOVES3 model source types 41, 42, 43, 51, 52, 53, 54, 61, and 62).

Onroad mobile source impacts were analyzed on days when the observed MDA8 ozone concentration exceeded the 2015 ozone NAAQS of 70 ppb at AQS monitors located within a 2008 and/or 2015 ozone nonattainment area. For selected states, modeled impacts were also evaluated at EJ zip codes in nonattainment areas on monitor exceedance days.

Relative source contributions at monitoring locations are presented, with contributions that equal or exceed 1% of the 2015 ozone NAAQS (0.70 ppb) highlighted in red and contributions that equal or exceed 0.5% of the 2015 ozone NAAQS (0.35 ppb) highlighted in yellow. Maximum source contributions for LDV, MHDV, and Total Vehicle (LDV+MHDV) are highlighted in bold. Relative source contributions from the model are adjusted to the monitoring data at AQS monitor locations using the methodology discussed in **Appendix A.** The resulting value gives a relative modeled contribution during a monitor exceedance day. Modeled contributions at EJ zip codes in nonattainment areas are presented as absolute modeled concentrations since there are no ozone monitors at the EJ zip code locations.

Spatial plots showing the absolute maximum modeled MDA8 ozone impacts (ppb) from onroad mobile sources are also presented for each state. LDV impacts, MHDV impacts, and the combination of the impacts (LDV+MHDV) for the 2016 base year and the 2023 projected future year are shown in separate plots. Transportation emissions were modeled as an "area wide" emissions source. Each grid cell in the model had some mobile source emissions. Emissions were much larger in urban areas compared to rural areas. Ozone impacts were widespread and far-reaching because the model tracked ozone attributable to all the onroad mobile source NOx and VOC emissions that are spread throughout each state. Maximum modeled impacts often occur in or near urban areas.

Connecticut

Impacts from Connecticut onroad mobile sources were evaluated at AQS monitors and at EJ zip codes located within Greater Connecticut and the CT portion of the New York-Northern New Jersey-Long Island 2008 and 2015 ozone nonattainment areas. Impacts were pulled for days where the monitored MDA8 ozone concentrations in the nonattainment area exceeded the 70 ppb NAAQS.

2016 modeled contributions and projected 2023 modeled contributions from Connecticut onroad mobile sources on 2016 nonattainment days are shown in **Tables 1 to 4**. Spatial plots showing

absolute MDA8 modeled ozone impacts from Connecticut mobiles sources (LDV, MHDV, and LDV+MHDV) during the 2016 ozone season (April to October) are shown in Figure 1.

Table 1. Maximum **2016** Modeled Impacts from **Connecticut** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Greater Connecticut Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
22-Apr	0.14	0.04	0.18	0.46	0.15	0.61
25-May	1.17	0.50	1.67	0.78	0.31	1.09
26-May	**3.75**	**1.73**	**5.48**	2.95	**1.37**	4.32
27-May	0.29	0.09	0.38	0.69	0.27	0.96
28-May	2.46	0.37	2.83	2.06	0.31	2.37
7-Jun	0.16	0.08	0.24	1.08	0.49	1.57
16-Jun	0.27	0.13	0.40	2.80	1.34	4.14
26-Jun	1.09	0.25	1.34	**3.85**	0.67	**4.52**
6-Jul	2.37	1.01	3.38	1.76	0.76	2.52
15-Jul	1.97	0.92	2.89	2.23	0.83	3.06
16-Jul	0.98	0.40	1.38	2.16	0.46	2.62
17-Jul	0.24	0.06	0.30	3.42	0.54	3.96
21-Jul	0.94	0.43	1.37	1.08	0.36	1.44
22-Jul	1.67	0.59	2.26	1.17	0.41	1.58
25-Jul	1.61	0.70	2.31	1.98	0.86	2.84
28-Jul	1.56	0.66	2.22	1.28	0.54	1.82
5-Aug	2.66	0.98	3.64	2.04	0.75	2.79
25-Aug	0.30	0.13	0.43	1.23	0.58	1.81
8-Sep	0.36	0.13	0.49	1.67	0.75	2.42
14-Sep	0.32	0.13	0.45	0.82	0.36	1.18

Table 2. Maximum **2023** Projected Modeled Impacts from **Connecticut** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Greater Connecticut Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
22-Apr	0.08	0.04	0.12	0.36	0.23	0.59
25-May	0.64	0.53	1.17	0.30	0.27	0.57
26-May	**1.39**	**1.32**	**2.71**	1.10	1.04	2.14
27-May	0.22	0.13	0.35	0.38	0.31	0.69
28-May	0.86	0.26	1.12	0.71	0.22	0.93
7-Jun	0.07	0.06	0.13	0.43	0.40	0.83
16-Jun	0.14	0.12	0.26	1.09	**1.05**	**2.14**
26-Jun	0.38	0.17	0.55	**1.41**	0.50	1.91
6-Jul	0.84	0.84	1.68	0.69	0.61	1.30
15-Jul	0.83	0.77	1.60	0.84	0.65	1.49
16-Jul	0.42	0.28	0.70	0.63	0.30	0.93
17-Jul	0.09	0.04	0.13	1.22	0.40	1.62
21-Jul	0.44	0.35	0.79	0.39	0.27	0.66
22-Jul	0.63	0.45	1.08	0.47	0.36	0.83
25-Jul	0.64	0.54	1.18	0.78	0.67	1.45
28-Jul	0.56	0.49	1.05	0.46	0.40	0.86
5-Aug	1.01	0.76	1.77	0.84	0.64	1.48
25-Aug	0.13	0.11	0.24	0.59	0.56	1.15
8-Sep	0.15	0.11	0.26	0.77	0.69	1.46
14-Sep	0.17	0.15	0.32	0.36	0.33	0.69

Table 3. Maximum **2016** Modeled Impacts from **Connecticut** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

New York-Northern New Jersey-Long Island, CT Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
22-Apr	0.48	0.15	0.63	0.11	0.04	0.15
12-May	1.67	0.79	2.46	0.63	0.30	0.93
25-May	2.08	0.83	2.91	0.51	0.24	0.75
26-May	2.22	1.11	3.33	0.97	**0.50**	1.47
27-May	0.12	0.03	0.15	0.13	0.07	0.20
28-May	1.74	0.28	2.02	0.34	0.07	0.41
29-May	0.58	0.07	0.65	0.26	0.05	0.31
7-Jun	0.45	0.21	0.66	0.29	0.15	0.44
16-Jun	1.57	0.66	2.23	0.77	0.31	1.08
21-Jun	2.08	0.93	3.01	0.85	0.43	1.28
23-Jun	2.19	1.03	3.22	0.46	0.20	0.66
26-Jun	1.10	0.24	1.34	0.71	0.16	0.87
6-Jul	**2.76**	**1.20**	**3.96**	0.92	0.47	1.39
12-Jul	0.67	0.27	0.94	0.83	0.37	1.20
15-Jul	1.84	0.60	2.44	0.73	0.30	1.03
17-Jul	0.81	0.14	0.95	**1.49**	0.27	**1.76**
18-Jul	0.93	0.38	1.31	0.33	0.17	0.50
21-Jul	1.83	0.72	2.55	0.72	0.36	1.08
22-Jul	1.10	0.36	1.46	0.19	0.07	0.26
11-Aug	0.71	0.27	0.98	0.06	0.03	0.09
12-Aug	1.39	0.44	1.83	0.38	0.14	0.52
13-Aug	0.55	0.10	0.65	0.65	0.11	0.76
24-Aug	0.52	0.25	0.77	0.82	0.41	1.23
31-Aug	0.33	0.13	0.46	0.43	0.20	0.63
8-Sep	0.33	0.13	0.46	0.26	0.10	0.36
14-Sep	0.50	0.19	0.69	0.20	0.09	0.29

Table 4. Maximum **2023** Projected Modeled Impacts from **Connecticut** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

New York-Northern New Jersey-Long Island, CT Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
22-Apr	0.30	0.18	0.48	0.04	0.05	0.09
12-May	0.58	0.51	1.09	0.29	0.30	0.59
25-May	0.78	0.62	1.40	0.24	0.25	0.49
26-May	0.82	0.80	1.62	**0.61**	**0.58**	**1.19**
27-May	0.10	0.06	0.16	0.07	0.10	0.17
28-May	0.66	0.21	0.87	0.17	0.06	0.23
29-May	0.20	0.05	0.25	0.14	0.05	0.19
7-Jun	0.20	0.19	0.39	0.16	0.17	0.33
16-Jun	0.64	0.54	1.18	0.35	0.31	0.66
21-Jun	0.80	0.72	1.52	0.40	0.44	0.84
23-Jun	**1.03**	**0.95**	**1.98**	0.32	0.30	0.62
26-Jun	0.39	0.17	0.56	0.28	0.13	0.41
6-Jul	1.03	0.90	1.93	0.36	0.38	0.74
12-Jul	0.27	0.21	0.48	0.39	0.37	0.76
15-Jul	0.54	0.34	0.88	0.27	0.24	0.51
17-Jul	0.28	0.10	0.38	0.51	0.19	0.70
18-Jul	0.44	0.36	0.80	0.16	0.16	0.32
21-Jul	0.68	0.64	1.32	0.28	0.28	0.56
22-Jul	0.49	0.32	0.81	0.10	0.10	0.20
11-Aug	0.54	0.40	0.94	0.04	0.04	0.08
12-Aug	0.63	0.40	1.03	0.18	0.16	0.34
13-Aug	0.25	0.10	0.35	0.30	0.10	0.40
24-Aug	0.23	0.22	0.45	0.35	0.37	0.72
31-Aug	0.17	0.16	0.33	0.21	0.20	0.41
8-Sep	0.18	0.14	0.32	0.17	0.14	0.31
14-Sep	0.26	0.21	0.47	0.11	0.11	0.22

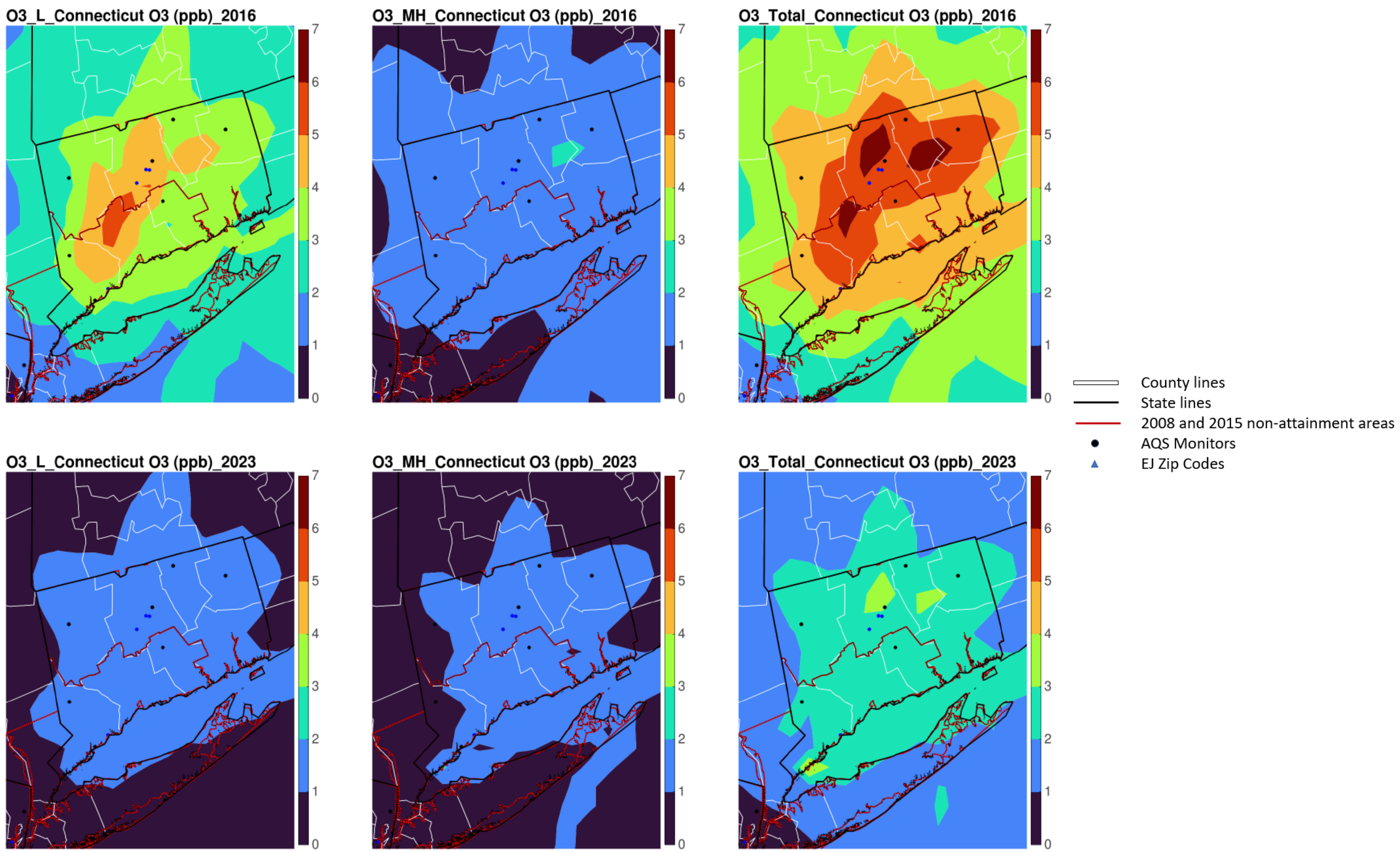

Figure 1. Absolute maximum modeled MDA8 ozone impacts (ppb) due to Connecticut onroad mobile sources during the 2016 ozone season (April to October). "L" denotes LDVs, "MH" denotes MHDVs, and "Total" denotes the combination of LDVs and MHDVs. 2016 shows base year modeled ozone impacts and 2023 shows projected future year modeled ozone impacts.

Illinois

Impacts from Illinois onroad mobile sources were evaluated at AQS monitors and at EJ zip codes located within the IL portion of Chicago and the IL portion of the St. Louis 2008 and 2015 ozone nonattainment areas. Impacts were pulled for days where the monitored MDA8 ozone concentrations in the nonattainment area exceeded the 70 ppb NAAQS.

2016 modeled contributions and projected 2023 modeled contributions from Illinois onroad mobile sources on 2016 nonattainment days are shown in **Tables 5 to 8**. Spatial plots showing absolute MDA8 modeled ozone impacts from Illinois mobiles sources (LDV, MHDV, and LDV+MHDV) during the 2016 ozone season (April to October) are shown in **Figure 2.**

Table 5. Maximum **2016** Modeled Impacts from **Illinois** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold.**

Chicago, IL Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
16-Apr	0.42	0.35	0.77	0.72	0.57	1.29
17-Apr	1.47	0.66	2.13	1.03	0.79	1.82
18-Apr	0.99	1.75	2.74	0.70	1.53	2.23
23-May	1.04	1.24	2.28	0.68	1.40	2.08
24-May	2.29	3.23	5.52	1.08	1.89	2.97
3-Jun	1.75	2.72	4.47	1.28	2.33	3.61
11-Jun	3.15	2.04	5.19	1.96	1.33	3.29
13-Jun	1.79	2.98	4.77	1.17	1.95	3.12
14-Jun	1.05	1.50	2.55	0.54	0.80	1.34
15-Jun	3.41	4.22	7.63	1.04	2.38	3.42
18-Jun	1.93	1.10	3.03	3.13	2.24	5.37
19-Jun	2.09	1.67	4.96	2.09	1.67	3.76
24-Jun	1.92	2.28	4.20	1.57	1.73	3.30
25-Jun	3.54	3.16	6.70	2.20	2.52	4.72
19-Jul	3.48	4.58	8.06	2.54	4.16	6.70
20-Jul	2.88	3.40	6.28	2.04	3.09	5.13
22-Jul	3.19	3.19	6.38	2.63	3.56	6.19
26-Jul	3.05	4.22	7.27	2.75	4.89	7.64
27-Jul	**4.96**	6.30	**11.26**	**3.28**	4.83	**8.11**
3-Aug	2.71	4.91	7.62	2.06	4.76	6.82
4-Aug	2.54	4.12	6.66	1.89	3.26	5.15
10-Aug	4.49	**6.42**	10.91	2.65	**5.21**	7.86

Table 6. Maximum **2023** Projected Modeled Impacts from **Illinois** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold.**

Chicago, IL Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
16-Apr	0.22	0.35	0.57	0.44	0.56	1.00
17-Apr	0.98	0.68	1.66	0.63	0.75	1.38
18-Apr	0.64	1.87	2.51	0.44	1.51	1.95
23-May	0.74	1.40	2.14	0.43	1.64	2.07
24-May	1.29	2.96	4.25	0.58	1.79	2.37
3-Jun	1.20	3.31	4.51	0.84	2.69	3.53
11-Jun	1.51	2.07	3.58	0.70	1.50	2.20
13-Jun	1.08	3.78	4.86	0.71	2.10	2.81
14-Jun	0.69	1.56	2.25	0.32	0.91	1.23
15-Jun	2.00	4.27	6.27	0.71	2.43	3.14
18-Jun	1.46	1.56	3.02	1.90	2.44	4.34
19-Jun	0.97	1.27	2.24	0.97	1.27	2.24
24-Jun	1.78	0.18	2.25	1.13	2.46	3.59
25-Jun	1.78	2.56	4.34	1.13	1.87	3.00
19-Jul	2.14	4.91	7.05	1.36	4.75	6.11
20-Jul	1.80	3.72	5.52	1.21	3.31	4.52
22-Jul	2.06	3.48	5.54	1.63	4.00	5.63
26-Jul	2.07	5.85	7.92	1.60	4.92	6.52
27-Jul	**3.06**	**7.07**	**10.13**	**2.03**	**5.22**	**7.25**
3-Aug	1.46	4.50	5.96	1.12	4.36	5.48
4-Aug	1.65	4.61	6.26	1.12	3.34	4.46
10-Aug	2.40	5.94	8.34	1.53	5.12	6.65

Table 7. Maximum **2016** Modeled Impacts from **Illinois** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

St. Louis, IL Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
23-May	**1.52**	1.31	2.83	1.11	1.12	2.23
9-Jun	0.50	0.62	1.12	0.56	0.74	1.30
10-Jun	1.24	1.57	2.81	0.51	0.63	1.14
13-Jun	1.44	1.84	3.28	0.89	1.10	1.99
16-Jun	0.21	0.25	0.46	0.24	0.30	0.54
18-Jun	0.97	0.74	1.71	0.97	0.66	1.63
24-Jun	0.39	0.41	0.80	0.59	0.61	1.20
4-Aug	1.41	**2.02**	**3.43**	**1.50**	**2.17**	**3.67**
9-Aug	0.80	1.02	1.82	0.63	0.83	1.46
22-Sep	0.37	0.41	0.78	0.39	0.50	0.89
23-Sep	0.25	0.31	0.56	0.48	0.61	1.09

Table 8. Maximum **2023** Projected Modeled Impacts from **Illinois** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

St. Louis, IL Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
23-May	**0.73**	0.97	1.70	0.55	0.89	1.44
9-Jun	0.24	0.46	0.70	0.27	0.53	0.80
10-Jun	0.69	1.33	2.02	0.25	0.49	0.74
13-Jun	0.70	1.38	2.08	0.45	0.86	1.31
16-Jun	0.11	0.20	0.31	0.16	0.35	0.51
18-Jun	0.45	0.52	0.97	0.42	0.46	0.88
24-Jun	0.21	0.35	0.56	0.35	0.59	0.94
4-Aug	0.70	**1.53**	**2.23**	**0.74**	**1.64**	**2.38**
9-Aug	0.49	1.02	1.51	0.37	0.78	1.15
22-Sep	0.22	0.37	0.59	0.22	0.45	0.67
23-Sep	0.15	0.28	0.43	0.27	0.59	0.86

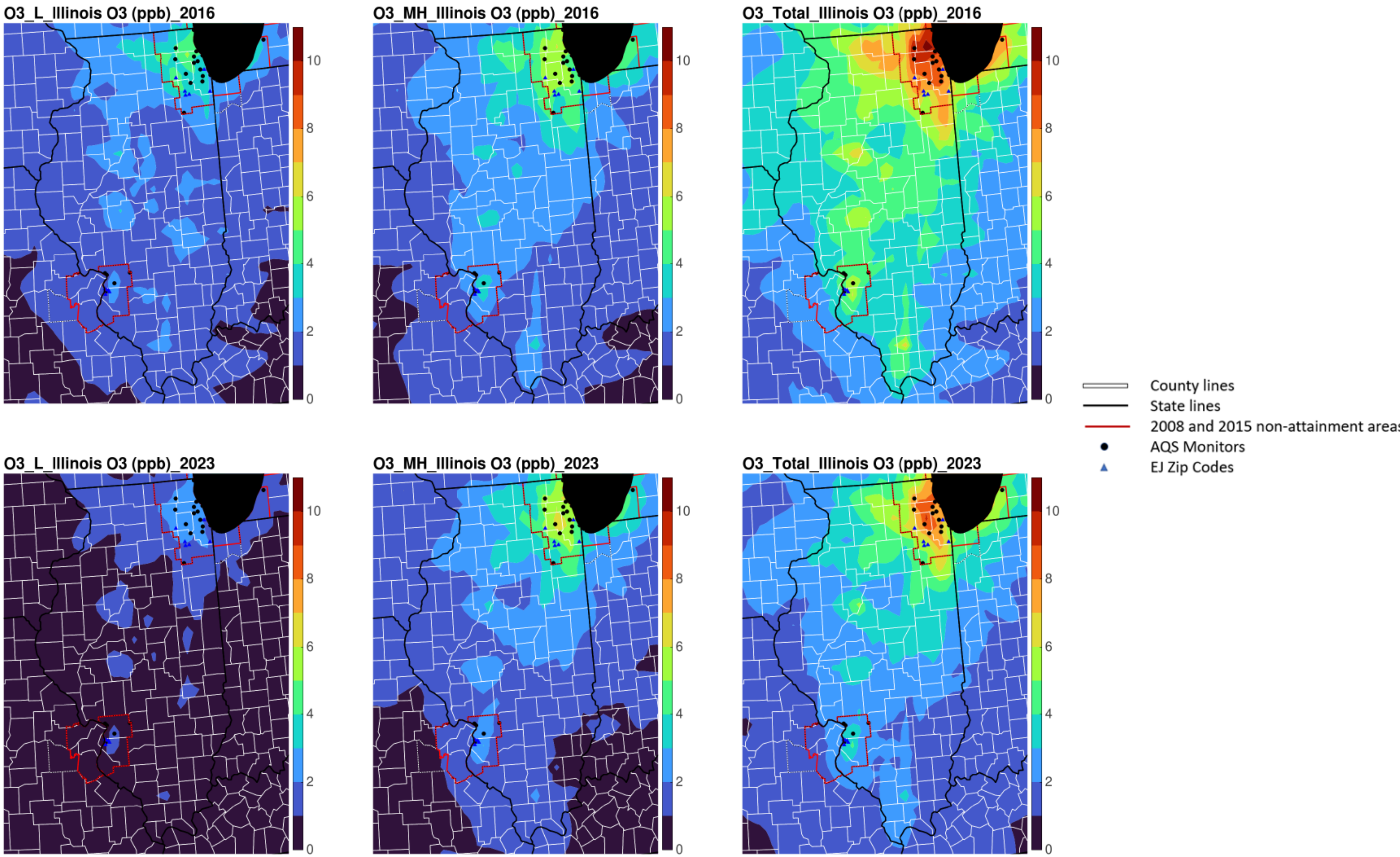

Figure 2. Absolute maximum modeled MDA8 ozone impacts (ppb) due to Illinois onroad mobile sources during the 2016 ozone season (April to October). "L" denotes LDVs, "MH" denotes MHDVs, and "Total" denotes the combination of LDVs and MHDVs. 2016 shows base year modeled ozone impacts and 2023 shows projected future year modeled ozone impacts.

Maryland

Impacts from Maryland onroad mobile sources were evaluated at AQS monitors located within Baltimore, the MD portion of the Philadelphia-Wilmington-Atlantic City, and the MD portion of Washington D.C. 2008 and 2015 ozone nonattainment areas. Impacts were pulled for days where the monitored MDA8 ozone concentrations in the nonattainment area exceeded the 70 ppb NAAQS.

2016 modeled contributions and projected 2023 modeled contributions from Maryland onroad mobile sources on 2016 nonattainment days are shown in **Tables 9 to 14**. Spatial plots showing absolute MDA8 modeled ozone impacts from Maryland mobiles sources (LDV, MHDV, and LDV+MHDV) during the 2016 ozone season (April to October) are shown in **Figure 3.**

Table 9. Maximum **2016** Modeled Impacts from **Maryland** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Baltimore, MD Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
25-May	2.86	3.08	5.94
26-May	2.39	2.62	5.01
27-May	3.13	3.31	6.44
28-May	4.83	5.52	10.35
1-Jun	3.93	4.82	8.75
20-Jun	4.45	5.26	9.71
6-Jul	3.66	4.86	8.52
16-Jul	3.68	4.58	8.26
19-Jul	3.23	3.90	7.13
21-Jul	4.74	**5.96**	10.70
22-Jul	3.82	4.12	7.94
25-Jul	4.27	5.23	9.50
26-Jul	2.79	3.41	6.20
27-Jul	4.29	3.88	8.17
29-Jul	2.92	3.13	6.05
29-Aug	**5.45**	5.70	**11.15**
31-Aug	5.09	5.86	10.95
7-Sep	1.36	1.44	2.80
14-Sep	3.57	4.30	7.87
22-Sep	1.26	1.42	2.68
23-Sep	4.34	3.93	8.27

Table 10. Maximum **2023** Projected Modeled Impacts from **Maryland** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Baltimore, MD Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	**MHDV**	**Total Vehicle**
25-May	1.28	2.73	4.01
26-May	1.31	2.78	4.09
27-May	0.84	3.25	4.09
28-May	2.20	4.85	7.05
1-Jun	1.90	4.35	6.25
20-Jun	1.98	4.58	6.56
6-Jul	1.57	4.18	5.75
16-Jul	1.82	4.66	6.48
19-Jul	1.23	2.82	4.05
21-Jul	2.17	5.16	7.33
22-Jul	1.85	3.97	5.82
25-Jul	2.29	4.96	7.25
26-Jul	1.22	2.98	4.20
27-Jul	2.40	4.68	7.08
29-Jul	1.54	3.22	4.76
29-Aug	**2.86**	**5.97**	**8.83**
31-Aug	2.33	5.20	7.53
7-Sep	0.99	2.27	3.26
14-Sep	1.84	4.29	6.13
22-Sep	0.65	1.46	2.11
23-Sep	2.43	4.61	7.04

Table 11. Maximum **2016** Modeled Impacts from **Maryland** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Philadelphia-Wilmington-Atlantic City, MD Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
25-May	1.84	2.24	4.08
11-Jun	1.88	2.16	4.04
20-Jun	**4.11**	**5.02**	**9.13**
25-Jul	3.63	4.96	8.59
27-Aug	0.99	0.93	1.92
14-Sep	0.87	1.25	2.12
22-Sep	0.17	0.19	0.36
23-Sep	3.31	3.48	6.79

Table 12. Maximum **2023** Projected Modeled Impacts from **Maryland** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Philadelphia-Wilmington-Atlantic City, MD Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
25-May	0.62	1.45	2.07
11-Jun	0.92	2.13	3.05
20-Jun	**1.71**	3.93	**5.64**
25-Jul	1.58	**3.98**	5.56
27-Aug	0.40	0.70	1.10
14-Sep	0.42	1.14	1.56
22-Sep	0.18	0.43	0.61
23-Sep	1.65	3.33	4.98

Table 13. Maximum **2016** Modeled Impacts from **Maryland** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Washington D.C., MD Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
18-Apr	2.36	1.79	4.15
19-Apr	1.21	1.15	2.36
25-May	2.20	2.13	4.33
26-May	2.06	1.87	3.93
1-Jun	4.38	5.39	9.77
20-Jun	3.58	3.19	6.77
21-Jul	**5.62**	**5.83**	**11.45**
26-Jul	3.67	4.16	7.83
27-Jul	2.80	2.32	5.12
23-Sep	5.02	3.97	8.99

Table 14. Maximum 2023 Projected Modeled Impacts from **Maryland** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Washington D.C., MD Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
18-Apr	1.54	2.37	3.91
19-Apr	0.73	1.41	2.14
25-May	1.18	2.15	3.33
26-May	1.04	1.77	2.81
1-Jun	1.99	4.47	6.46
20-Jun	1.64	2.69	4.33
21-Jul	2.64	**5.25**	**7.89**
26-Jul	1.86	4.08	5.94
27-Jul	2.16	4.00	6.16
23-Sep	**2.78**	4.23	7.01

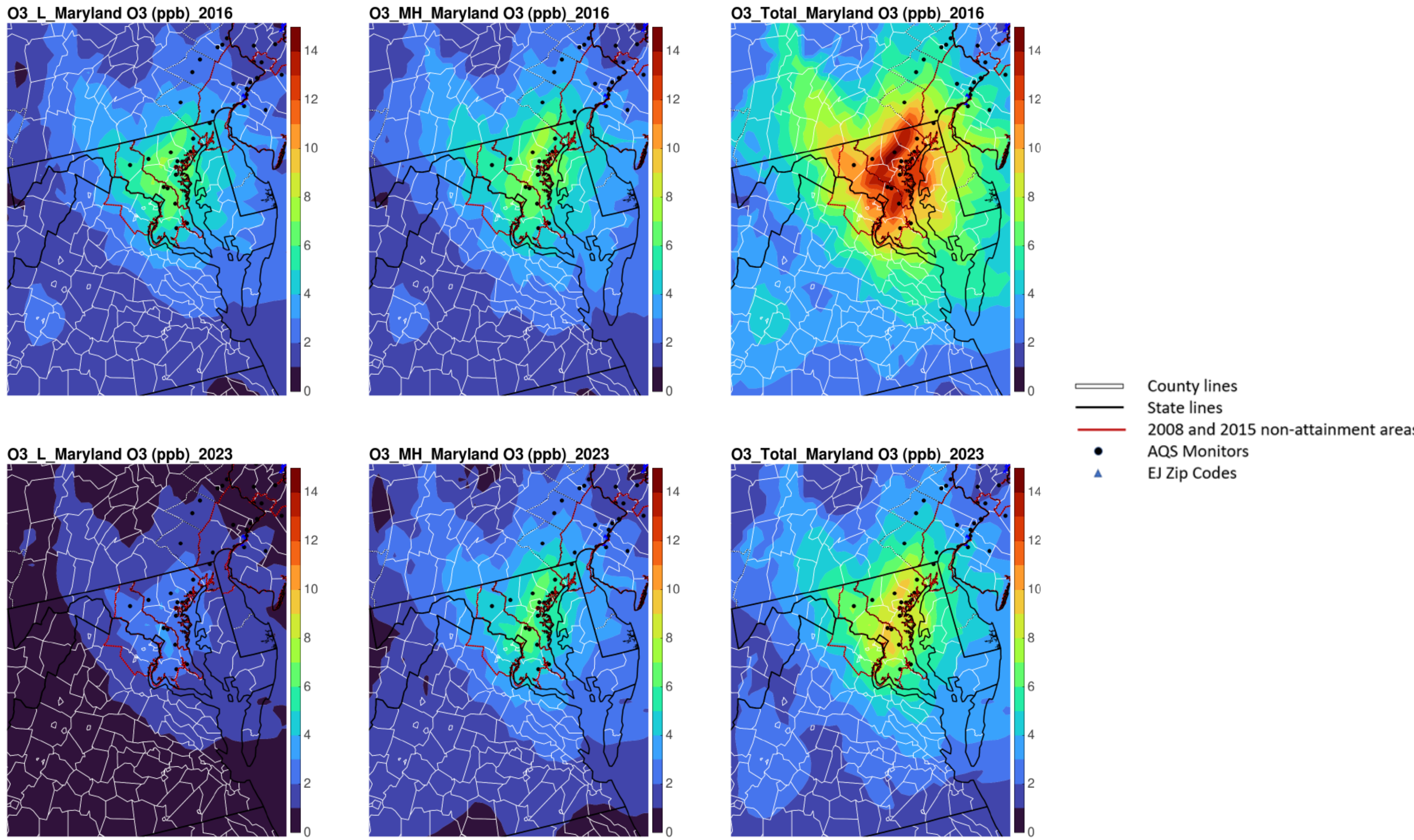

Figure 3. Absolute maximum modeled MDA8 ozone impacts (ppb) due to Maryland onroad mobile sources during the 2016 ozone season (April to October). "L" denotes LDVs, "MH" denotes MHDVs, and "Total" denotes the combination of LDVs and MHDVs. 2016 shows base year modeled ozone impacts and 2023 shows projected future year modeled ozone impacts.

Michigan

Impacts from Michigan onroad mobile sources were evaluated at AQS monitors and EJ zip codes located within Allegan County, Berrien County, Detroit, and Muskegon County 2015 ozone nonattainment areas. Impacts were pulled for days where the monitored MDA8 ozone concentrations in the nonattainment area exceeded the 70 ppb NAAQS.

2016 modeled contributions and projected 2023 modeled contributions from Michigan onroad mobile sources on 2016 nonattainment days are shown in **Tables 15 to 22**. Spatial plots showing absolute MDA8 modeled ozone impacts from Michigan mobiles sources (LDV, MHDV, and LDV+MHDV) during the 2016 ozone season (April to October) are shown in **Figure 4.**

Table 15. Maximum **2016** Modeled Impacts from **Michigan** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Allegan County, MI Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
16-Apr	2.68	0.79	3.47
17-Apr	2.48	0.53	3.01
18-Apr	1.96	0.91	2.87
25-May	1.97	1.38	3.35
10-Jun	0.71	0.37	1.08
11-Jun	0.29	0.08	0.37
19-Jun	0.91	0.28	1.19
25-Jun	**3.19**	**1.43**	**4.62**
6-Jul	0.30	0.18	0.48

Table 16. Maximum Projected **2023** Modeled Impacts from **Michigan** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Allegan County, MI Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
16-Apr	1.34	0.65	1.99
17-Apr	1.40	0.48	1.88
18-Apr	1.37	1.05	2.42
25-May	0.90	1.01	1.91
10-Jun	0.34	0.30	0.64
11-Jun	0.12	0.05	0.17
19-Jun	0.41	0.20	0.61
25-Jun	**1.41**	**1.08**	**2.49**
6-Jul	0.14	0.14	0.28

Table 17. Maximum **2016** Modeled Impacts from **Michigan** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Berrien County, MI Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
17-Apr	2.31	0.83	3.14
18-Apr	2.10	**1.57**	3.67
23-May	**2.48**	1.30	**3.78**
24-May	1.17	0.66	1.83
10-Jun	0.51	0.33	0.84
11-Jun	0.15	0.05	0.20
15-Jun	0.54	0.38	0.92
19-Jun	0.83	0.28	1.11
20-Jun	0.37	0.26	0.63
25-Jun	2.14	0.93	3.07
30-Jun	0.69	0.42	1.11

Table 18. Maximum **2023** Modeled Impacts from **Michigan** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Berrien County, MI Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
17-Apr	1.16	0.70	1.86
18-Apr	1.23	**1.53**	**2.76**
23-May	**1.24**	1.14	2.38
24-May	0.61	0.60	1.21
10-Jun	0.27	0.29	0.56
11-Jun	0.08	0.05	0.13
15-Jun	0.26	0.30	0.56
19-Jun	0.37	0.22	0.59
20-Jun	0.21	0.23	0.44
25-Jun	0.94	0.70	1.64
30-Jun	0.30	0.32	0.62

Table 19. Maximum **2016** Modeled Impacts from **Michigan** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Detroit, MI Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
17-Apr	1.75	0.72	2.47	0.63	0.15	0.78
18-Apr	2.92	1.47	4.39	1.05	0.86	1.91
23-May	2.07	1.43	3.50	0.93	0.61	1.54
24-May	3.42	2.31	5.73	1.69	1.19	2.88
25-May	2.37	2.20	4.57	0.58	0.56	1.14
10-Jun	0.82	0.67	1.49	0.26	0.22	0.48
18-Jun	5.74	3.00	8.74	2.21	0.88	3.09
19-Jun	3.55	0.98	4.53	1.01	0.36	1.37
30-Jun	5.75	3.24	8.99	3.32	2.05	5.37
27-Jul	**7.94**	**6.42**	**14.36**	**4.96**	4.03	**8.99**
10-Aug	6.50	5.27	11.77	4.81	**4.08**	8.89

Table 20. Maximum **2023** Projected Modeled Impacts from **Michigan** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Detroit, MI Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
17-Apr	1.30	0.38	1.68	0.45	0.15	0.60
18-Apr	1.76	1.33	3.09	0.64	0.89	1.53
23-May	1.00	1.04	2.04	0.67	0.66	1.33
24-May	1.96	2.18	4.14	0.90	1.10	2.00
25-May	1.44	2.15	3.59	0.33	0.54	0.87
10-Jun	0.62	0.96	1.58	0.19	0.31	0.50
18-Jun	3.30	2.55	5.85	1.67	1.08	2.75
19-Jun	1.91	0.77	2.68	0.56	0.30	0.86
30-Jun	3.77	4.22	7.99	1.74	1.91	3.65
27-Jul	**4.31**	5.71	10.02	2.54	3.44	5.98
10-Aug	4.28	**5.84**	**10.12**	**2.86**	**3.93**	**6.79**

Table 21. Maximum **2016** Modeled Impacts from **Michigan** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Muskegon County, MI Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
17-Apr	3.38	0.54	3.92
18-Apr	**3.44**	**1.24**	**4.68**
24-May	0.80	0.35	1.15
25-May	1.34	0.70	2.04
10-Jun	0.37	0.17	0.54
19-Jun	0.56	0.16	0.72
25-Jun	1.90	0.93	2.83

Table 22. Maximum **2023** Projected Modeled Impacts from **Michigan** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Muskegon County, MI Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
17-Apr	1.55	0.37	1.92
18-Apr	**1.74**	**0.99**	**2.73**
24-May	0.40	0.29	0.69
25-May	0.66	0.53	1.19
10-Jun	0.18	0.15	0.33
19-Jun	0.27	0.13	0.40
25-Jun	0.80	0.70	1.50

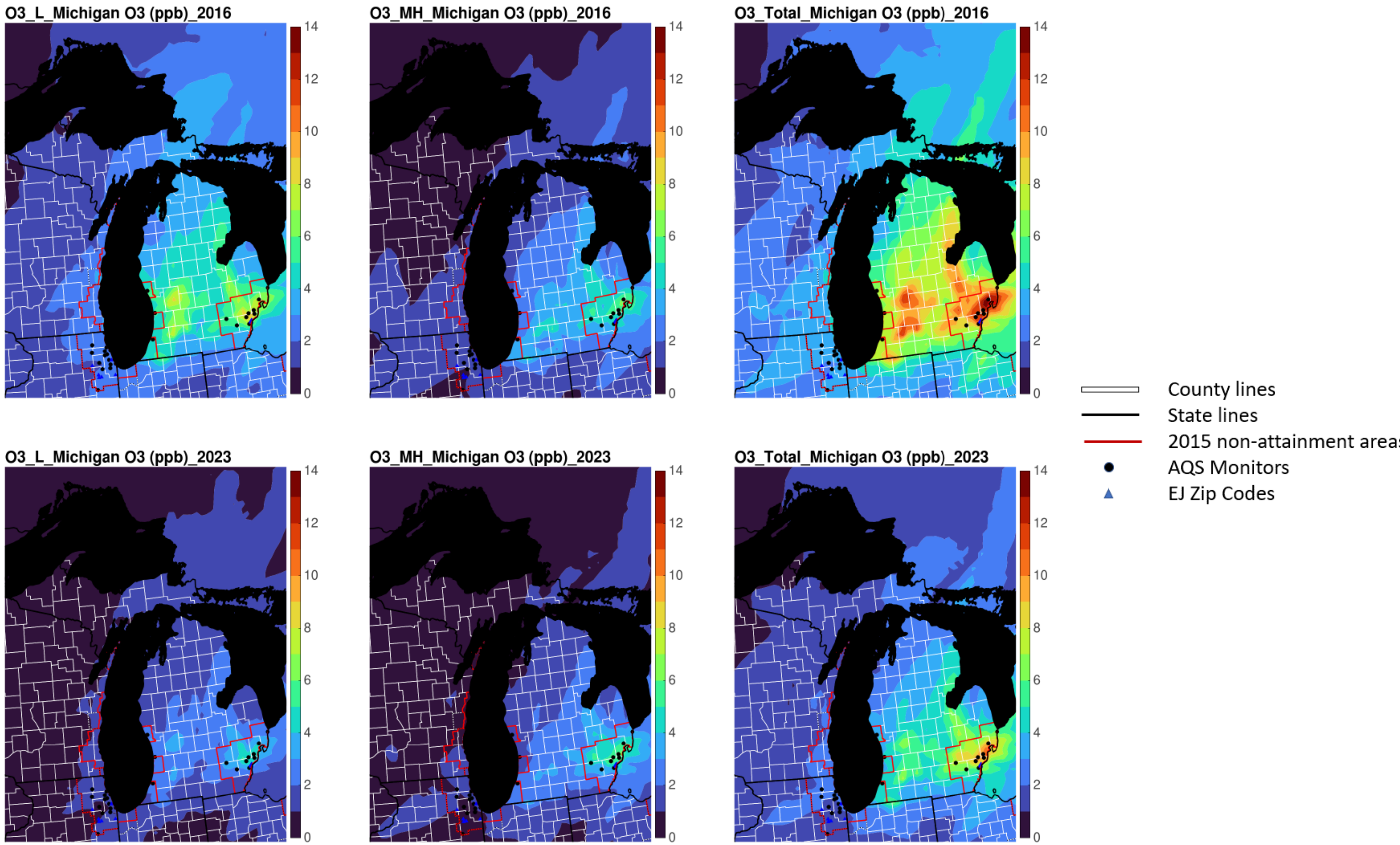

Figure 4. Absolute maximum modeled MDA8 ozone impacts (ppb) due to Michigan onroad mobile sources during the 2016 ozone season (April to October). "L" denotes LDVs, "MH" denotes MHDVs, and "Total" denotes the combination of LDVs and MHDVs. 2016 shows base year modeled ozone impacts and 2023 shows projected future year modeled ozone impacts.

New Jersey

Impacts from New Jersey onroad mobile sources were evaluated at AQS monitors and EJ zip codes located within the NJ portion of New York-Northern New Jersey-Long Island and the NJ portion of Philadelphia-Wilmington-Atlantic City 2008 and 2015 ozone nonattainment areas. Impacts were pulled for days where the monitored MDA8 ozone concentrations in the nonattainment area exceeded the 70 ppb NAAQS.

2016 modeled contributions and projected 2023 modeled contributions from New Jersey onroad mobile sources on 2016 nonattainment days are shown in **Tables 23 to 26**. Spatial plots showing absolute MDA8 modeled ozone impacts from New Jersey mobiles sources (LDV, MHDV, and LDV+MHDV) during the 2016 ozone season (April to October) are shown in **Figure 5.**

Table 23. Maximum **2016** Modeled Impacts from **New Jersey** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

New York-Northern New Jersey-Long Island, NJ Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
25-May	1.36	1.57	2.93	1.02	1.32	2.34
26-May	1.80	2.53	4.33	1.68	2.31	3.99
27-May	1.73	1.93	3.66	1.16	1.28	2.44
28-May	1.97	2.25	4.22	2.27	2.54	4.81
1-Jun	1.68	2.21	3.89	1.82	1.95	3.77
11-Jun	0.86	0.50	1.36	0.42	0.48	0.90
15-Jun	1.12	1.66	2.78	1.82	2.40	4.22
19-Jun	**3.75**	3.48	**7.23**	1.97	1.47	3.44
20-Jun	2.04	2.71	4.75	2.07	2.68	4.75
24-Jun	1.19	1.15	2.34	0.81	0.71	1.52
6-Jul	2.05	2.17	4.22	2.37	3.15	5.52
16-Jul	0.88	0.87	1.75	2.40	2.36	4.76
21-Jul	1.96	2.65	4.56	1.94	2.71	4.65
22-Jul	1.16	1.47	2.63	1.33	1.63	2.96
28-Jul	2.60	**3.64**	6.24	**2.92**	**3.88**	**6.80**
29-Jul	2.88	3.04	5.92	1.98	2.53	4.51
24-Aug	1.85	2.40	4.25	2.41	3.42	5.83
23-Sep	0.78	0.74	1.52	1.86	2.17	4.03

Table 24. Maximum **2023** Projected Modeled Impacts from **New Jersey** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

New York-Northern New Jersey-Long Island, NJ Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
25-May	0.38	1.26	1.64	0.32	1.06	1.38
26-May	0.64	1.87	2.51	0.76	1.90	2.66
27-May	0.73	1.54	2.27	0.55	1.17	1.72
28-May	0.78	1.63	2.41	0.86	1.81	2.67
1-Jun	0.70	1.76	2.46	0.60	1.19	1.79
11-Jun	0.27	0.35	0.62	0.19	0.44	0.63
15-Jun	0.42	1.17	1.59	0.61	2.02	2.63
19-Jun	1.39	2.40	3.79	0.85	1.23	2.08
20-Jun	0.83	2.04	2.87	0.97	2.31	3.28
24-Jun	0.50	0.93	1.43	0.33	0.53	0.86
6-Jul	0.92	1.73	2.65	0.94	2.38	3.32
16-Jul	0.39	0.68	1.07	1.03	1.90	2.93
21-Jul	0.22	1.98	3.28	0.72	1.90	2.62
22-Jul	0.47	1.15	1.62	0.52	1.27	1.79
28-Jul	1.09	2.99	4.08	**1.12**	**3.06**	**4.18**
29-Jul	**1.43**	**3.01**	**4.44**	0.82	1.86	2.68
24-Aug	0.89	2.23	3.12	1.07	2.93	4.00
23-Sep	0.34	0.62	0.96	0.87	2.10	2.97

Table 25. Maximum **2016** Modeled Impacts from **New Jersey** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Philadelphia-Wilmington-Atlantic City, NJ Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
12-May	1.25	0.86	2.11
25-May	0.02	0.02	0.04
26-May	0.44	0.41	0.85
27-May	0.07	0.06	0.13
28-May	1.25	0.11	0.26
1-Jun	**1.95**	**1.64**	**3.59**
11-Jun	0.48	0.30	0.78
15-Jun	0.74	0.60	1.34
20-Jun	0.35	0.32	0.67
24-Jun	1.10	0.93	2.03
26-Jun	1.35	0.94	2.29
8-Jul	0.77	0.77	1.54
21-Jul	0.38	0.39	0.77
22-Jul	0.18	0.15	0.33
25-Jul	0.23	0.23	0.46
27-Jul	1.46	1.53	2.99
24-Aug	0.33	0.34	0.67
31-Aug	0.52	0.54	1.06
14-Sep	0.94	0.71	1.65
23-Sep	1.44	0.88	2.32

Table 26. Maximum **2023** Projected Modeled Impacts from **New Jersey** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Philadelphia-Wilmington-Atlantic City, NJ Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
12-May	0.67	0.75	1.42
25-May	0.01	0.02	0.03
26-May	0.18	0.30	0.48
27-May	0.03	0.04	0.07
28-May	0.22	0.07	0.48
1-Jun	**0.79**	1.19	1.98
11-Jun	0.17	0.17	0.34
15-Jun	0.36	0.57	0.93
20-Jun	0.13	0.22	0.35
24-Jun	0.41	0.66	1.07
26-Jun	0.45	0.57	1.02
8-Jul	0.31	0.59	0.90
21-Jul	0.14	0.27	0.41
22-Jul	0.07	0.10	0.17
25-Jul	0.10	0.19	0.29
27-Jul	0.67	**1.35**	**2.02**
24-Aug	0.14	0.18	1.02
31-Aug	0.21	0.39	0.60
14-Sep	0.38	0.53	0.91
23-Sep	0.67	0.82	1.49

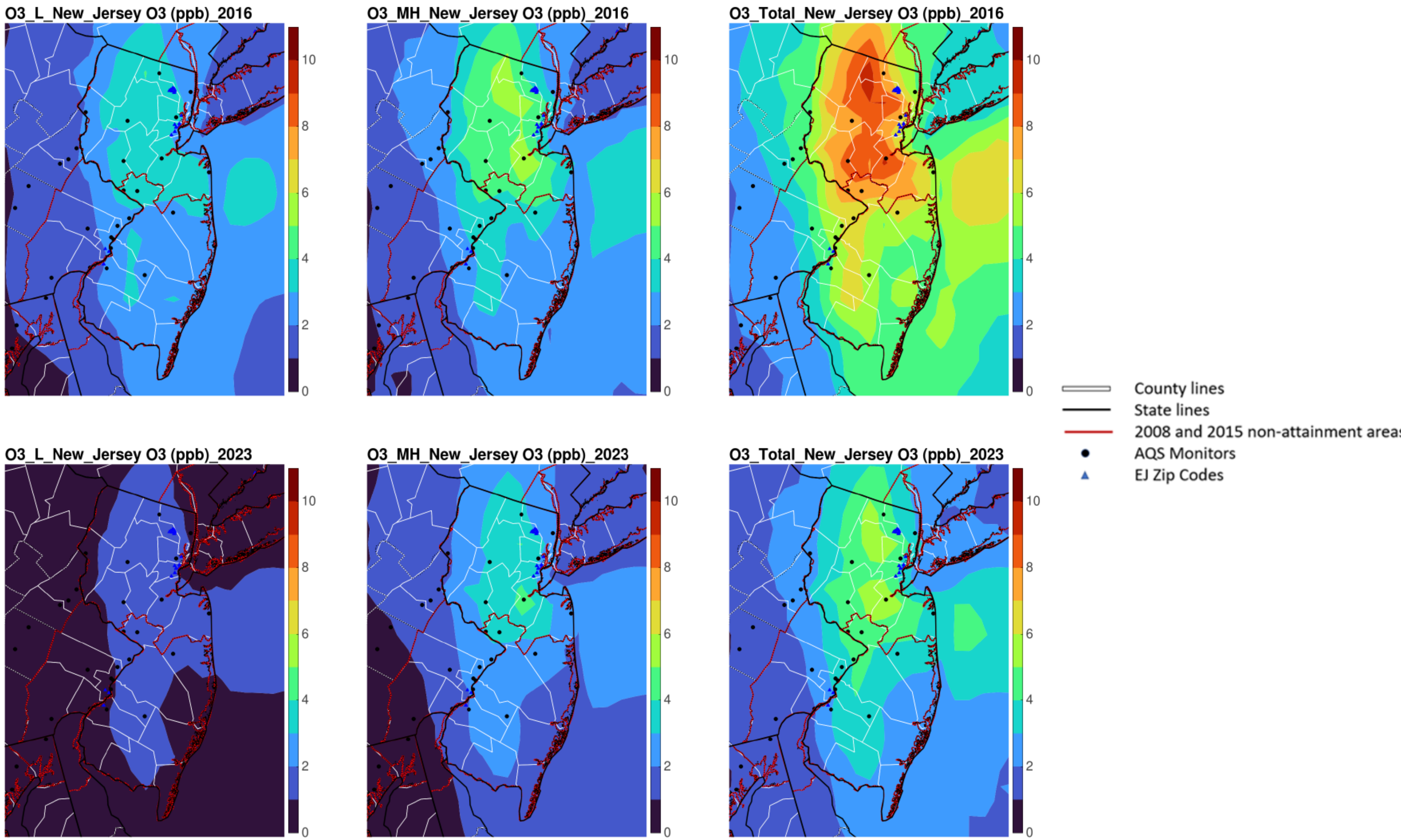

Figure 5. Absolute maximum modeled MDA8 ozone impacts (ppb) due to New Jersey onroad mobile sources during the 2016 ozone season (April to October). "L" denotes LDVs, "MH" denotes MHDVs, and "Total" denotes the combination of LDVs and MHDVs. 2016 shows base year modeled ozone impacts and 2023 shows projected future year modeled ozone impacts.

Pennsylvania

Impacts from Pennsylvania onroad mobile sources were evaluated at AQS monitors and EJ zip codes located within Lancaster County, Pittsburgh-Beaver Valley, and Reading County 2008 ozone nonattainment areas, and within the PA portion of the Philadelphia-Wilmington-Atlantic City, PA 2008 and 2015 ozone nonattainment area. Impacts were pulled for days where the monitored MDA8 ozone concentrations in the nonattainment area exceeded the 70 ppb NAAQS.

2016 modeled contributions and projected 2023 modeled contributions from Pennsylvania onroad mobile sources on 2016 nonattainment days are shown in **Tables 27 to 34**. Spatial plots showing absolute MDA8 modeled ozone impacts from Pennsylvania mobiles sources (LDV, MHDV, and LDV+MHDV) during the 2016 ozone season (April to October) are shown in **Figure 6.**

Table 27. Maximum **2016** Modeled Impacts from **Pennsylvania** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Lancaster County, PA Nonattainment Area Receptors

Ozone Nonattainment Day	**Max Ozone Impact at any AQS Monitor (ppb)**		
	LDV	**MHDV**	**Total Vehicle**
25-May	1.65	2.15	3.80
1-Jun	2.64	**3.29**	5.93
23-Sep	**2.92**	3.22	**6.14**

Table 28. Maximum **2023** Projected Modeled Impacts from **Pennsylvania** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Lancaster County, PA Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
25-May	0.81	1.82	2.63
1-Jun	1.18	2.61	3.79
23-Sep	**1.66**	**3.16**	**4.82**

Table 29. Maximum **2016** Modeled Impacts from **Pennsylvania** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Philadelphia-Wilmington-Atlantic City, PA Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
25-May	2.28	2.61	4.89	1.29	1.56	2.85
26-May	1.40	1.42	2.82	0.50	0.58	1.08
1-Jun	1.76	2.17	3.93	1.60	1.96	3.56
11-Jun	1.61	1.54	3.15	0.77	0.77	1.54
15-Jun	2.52	2.61	5.13	1.15	1.49	2.64
20-Jun	4.26	4.64	8.90	**2.85**	**3.15**	**6.00**
25-Jun	1.90	1.74	3.64	1.11	0.87	1.98
21-Jul	**4.68**	**5.59**	**10.27**	2.43	3.00	5.43
22-Jul	1.39	1.47	2.86	0.77	0.82	1.59
31-Aug	4.08	4.39	8.47	2.28	2.63	4.91
14-Sep	1.71	2.02	3.73	1.93	2.30	4.23
22-Sep	1.10	0.57	1.67	0.47	0.47	0.94
23-Sep	3.84	4.05	7.89	2.45	2.42	4.87

Table 30. Maximum **2023** Projected Modeled Impacts from **Pennsylvania** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Philadelphia-Wilmington-Atlantic City, PA Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
25-May	1.13	2.33	3.46	0.59	1.32	1.91
26-May	0.73	1.36	2.09	0.21	0.50	0.71
1-Jun	0.80	1.68	2.48	0.67	1.54	2.21
11-Jun	0.72	1.23	1.95	0.32	0.56	0.88
15-Jun	1.50	2.94	4.44	0.57	1.29	1.86
20-Jun	1.94	3.84	5.78	1.23	**2.45**	**3.68**
25-Jun	0.83	1.55	2.38	0.46	0.81	1.27
21-Jul	**2.21**	**4.90**	**7.11**	1.06	2.38	3.44
22-Jul	0.65	1.36	2.01	0.35	0.74	1.09
31-Aug	2.16	4.51	6.67	1.07	2.25	3.32
14-Sep	0.82	1.73	2.55	0.93	2.07	3.00
22-Sep	0.83	1.12	1.95	0.24	0.49	0.73
23-Sep	2.00	3.83	5.83	**1.28**	2.35	3.63

Table 31. Maximum **2016** Modeled Impacts from **Pennsylvania** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and absolute values (ppb) at EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Pittsburgh-Beaver Valley, PA Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
25-Jun	2.35	2.83	5.18	2.77	**3.91**	**6.68**
21-Jul	1.68	2.05	3.73	1.65	2.22	3.87
27-Jul	2.24	**3.16**	5.40	2.39	2.96	5.35
5-Sep	**3.20**	3.08	**6.28**	**3.01**	2.77	5.78
23-Sep	1.12	1.43	2.55	1.04	1.26	2.30

Table 32. Maximum **2023** Projected Modeled Impacts from **Pennsylvania** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors and EJ zip codes. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Pittsburgh-Beaver Valley, PA Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)			Max Ozone Impact at any EJ zip code (ppb)		
	LDV	MHDV	Total Vehicle	LDV	MHDV	Total Vehicle
25-Jun	1.06	2.22	3.28	1.27	2.91	4.18
21-Jul	0.88	1.81	2.69	0.89	1.97	2.86
27-Jul	1.23	**2.85**	4.08	1.57	**3.41**	**4.98**
5-Sep	**1.71**	2.72	**4.43**	**1.67**	2.53	4.20
23-Sep	0.65	1.42	2.07	0.65	1.36	2.01

Table 33. Maximum **2016** Modeled Impacts from **Pennsylvania** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Reading County, PA Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
25-May	1.76	2.57	4.33
24-Jun	0.81	0.93	1.74
21-Jul	**4.31**	**6.01**	**10.32**

Table 34. Maximum **2023** Projected Modeled Impacts from **Pennsylvania** onroad mobile sources on days that exceeded the ozone NAAQS of 70 ppb at any monitor in the nonattainment area during the 2016 ozone season. 8-hr maximum modeled ozone contributions are relative values (ppb) at AQS monitors. Values that equal or exceed 1% of the NAAQS (0.70 ppb) are highlighted in red, while values that equal or exceed 0.5% of the NAAQS (0.35 ppb) are highlighted in yellow. Maximum source contributions are highlighted in **bold**.

Reading County, PA Nonattainment Area Receptors

Ozone Nonattainment Day	Max Ozone Impact at any AQS Monitor (ppb)		
	LDV	MHDV	Total Vehicle
17-Apr	0.80	1.99	2.79
18-Apr	0.49	1.09	1.58
24-May	**1.85**	**4.43**	**6.28**

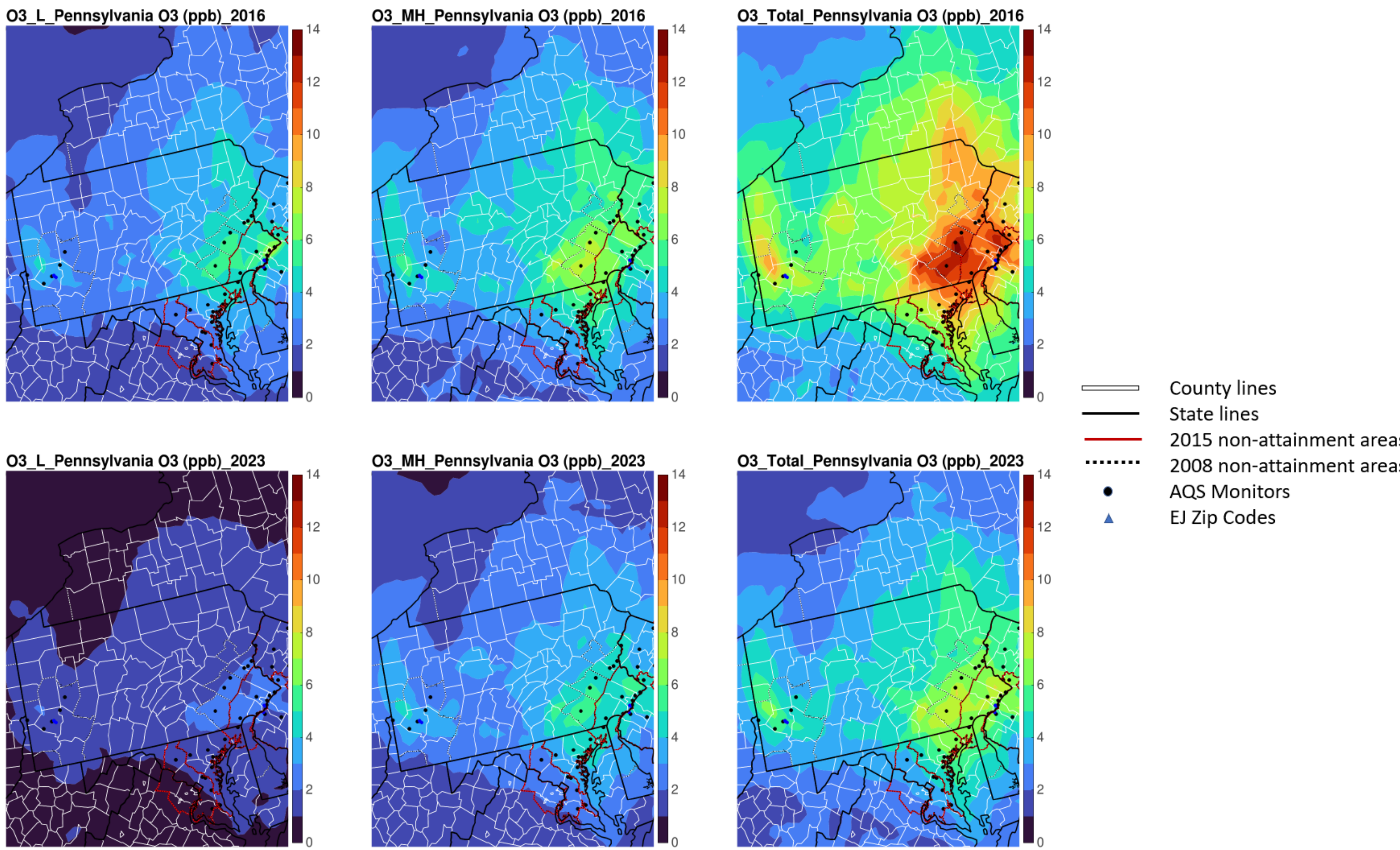

Figure 6. Absolute maximum modeled MDA8 ozone impacts (ppb) due to Pennsylvania onroad mobile sources during the 2016 ozone season (April to October). "L" denotes LDVs, "MH" denotes MHDVs, and "Total" denotes the combination of LDVs and MHDVs. 2016 shows base year modeled ozone impacts and 2023 shows projected future year modeled ozone impacts.

Appendix A. Modeling Methods

Photochemical Grid Model and Source Apportionment

To quantify the ozone impacts due to precursor emissions from mobile sources and other emission source groups, Sonoma Technology performed CAMx OSAT source apportionment model simulations for the 2016 ozone season (April to October). CAMx OSAT simulations were also conducted for the 2023 future year.[3] The modeling domain covers all lower 48 U.S. states, plus adjacent portions of Canada and Mexico, using a horizontal grid resolution of 12 km x 12 km. The domain and configurations used were based on those developed by EPA in recent ozone transport assessments using CAMx OSAT (U.S. Environmental Protection Agency, 2022a), and included the use of the carbon-bond 6 gas phase chemistry mechanism and the two-mode course/fine (CF) aerosol chemistry mechanism.

The Comprehensive Air Quality Model with Extensions (CAMx version 7.10) (Ramboll US Corporation, 2020) is a publicly available, peer-reviewed, state-of-the-science three-dimensional grid-based (Eulerian) photochemical air quality model designed to simulate the emission, transport, diffusion, chemical transformation, and removal of gaseous and particle pollutants in the atmosphere over spatial scales ranging from continental to urban. CAMx was designed to approach air quality wholistically by including capabilities for modeling multiple air quality issues, including tropospheric ozone, fine particles, visibility degradation, acid deposition, air toxics, and mercury. The ability of photochemical grid models, such as CAMx, to treat a large number of sources and their chemical interactions makes them well suited for assessing the impacts of natural and anthropogenic emissions sources on air quality. CAMx is widely used to support regulatory air quality assessments and air quality management policy decisions in the United States. In recent years, the EPA has used CAMx to support the NAAQS designation process (U.S. Environmental Protection Agency, 2015) and evaluate interstate pollutant transport (U.S. Environmental Protection Agency 2015a, 2021a, 2022a).

CAMx also includes OSAT, which can be used to estimate the contributions of individual sources, groups of sources, or source regions to ozone concentrations at a given receptor location (Yarwood et al., 1996). Source apportionment modeling is useful for understanding model performance, designing emission control strategies, and performing culpability assessments to identify emission sources that contribute significantly to pollution. The key precursor species for ozone production are volatile organic compounds (VOC) and oxides of nitrogen (NO_x). OSAT uses reactive tracers to track the fate of these precursor emissions and the ozone formation resulting from them within a CAMx simulation. The ozone and precursors are tracked and apportioned by OSAT without perturbing the host model chemistry; therefore, the OSAT results are fully consistent with the host model results for total concentrations. OSAT can efficiently estimate source contributions from multiple emission

[3] Future year ozone is modeled using emissions that have been projected to the future year, but using meteorology, boundary conditions, and other inputs representative of the 2016 base year.

sources within a single model simulation. Importantly, while source apportionment modeling can be used to estimate source contributions to ozone concentrations for a given set of emission inputs, sensitivity modeling approaches such as brute-force modeling[4] or the direct decoupled method (DDM)[5] are needed to quantify the effect of a given emission control scenario (e.g., 90% NO_x reduction) on ozone concentrations.

2016 EPA Model Platform

The CAMx OSAT simulations were based on EPA's 2016 air quality modeling platform. A modeling platform consists of a structured system of connected data and models that provide a consistent and transparent basis for assessing the air quality impact of anticipated changes in emissions. EPA typically develops and evaluates a new modeling platform each time the National Emissions Inventory (NEI) is updated (every three years). EPA has recently used the 2016 modeling platform to support the proposed Federal Implementation Plan ("Transport Rule") to help states fully resolve their obligations under the "Good Neighbor" provision of the Clean Air Act for the 2015 ozone NAAQS (U.S. Environmental Protection Agency, 2022a).

The CAMx OSAT simulations relied on EPA's 2016v2 (2016fj_16j) modeling platform. This platform draws on emissions data from the 2017 NEI (released spring of 2020) and data developed by the National Emissions Inventory Collaborative.[6] The NEI is compiled by EPA on a triennial basis, primarily from data submitted by state, local, and tribal air agencies. The 2017 NEI includes emissions from five source sectors: point sources, nonpoint (or area) sources, onroad mobile sources, nonroad mobile sources, and fire events. These NEI source sectors are divided into 20 sectors for the modeling platform. For the 2016v2 modeling platform, EPA updated the 2017 NEI data to represent year 2016 through the incorporation of 2016-specific state and local data along with adjustment methods appropriate for each emission sector.

For air quality modeling purposes, the 2016 NEI data was augmented by EPA to include biogenic emissions and data from Canadian and Mexican emissions inventories. In addition, the annualized point source data for EGUs in the NEI were replaced with hourly 2016 continuous emissions monitoring (CEMS) data from EPA's Clean Air Markets Division for SO_2 and NO_x. Annual emissions for pollutants were converted to an hourly basis using CEMS input data (U.S. Environmental Protection Agency, 2022c). The EGUs in the modeling platform are matched to units found in the National Electric Energy Data System (NEEDS) v6.20 database.[7] Onroad and nonroad mobile source emissions

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[4] The brute-force modeling method involves running the model both with and without emission controls applied to the source(s) of interest. The difference in pollutant concentrations between the two simulations yields the impact of the emission control scenario.
[5] DDM provides sensitivity coefficients that relate emissions changes to model outcomes. These sensitivity coefficients can be used to evaluate how pollutant concentrations would respond to a range of changes in emissions from a source or group of sources.
[6] The National Emissions Inventory Collaborative is a partnership between state emissions inventory staff, multi-jurisdictional organizations, federal land managers, EPA, and others to develop a North American air pollution emissions modeling platform for use in air quality planning.
[7] https://www.epa.gov/airmarkets/national-electric-energy-data-system-needs-v6 dated 5/28/2021.

were developed using the version 3 of the Motor Vehicle Emissions Simulator (MOVES3) using activity data provided by state and local agencies.

EPA also developed emission inventories for future years of 2023 (2023fj_16j), 2026 (2026fj_16j), and 2032 (2032fj_16j). EPA used sector-specific methods to project the 2016 base year emissions into the future. EGU emissions were projected using the Integrated Planning Model (IPM).[8] Onroad and nonroad mobile source emissions were projected using MOVES3 and activity data based on trends derived from the Federal Highway Administration (FHWA) county-level VM-2 reports as well as the Energy Information Administration's 2020 and 2021 Annual Energy Outlook (AEO). Emissions for other sectors were projected to the future year by adjusting the base year emissions to account for on-the-books regulations, known facility openings and closures, and estimated changes in activity. Biogenic, fire, and fertilizer emissions were held constant from the base year. A summary of NO_x and VOC emissions for the 2016 and 2023 inventories is shown in Table A-1 and Table A-2.

Table A-1. Summary of national ozone season NO_x emissions by source sector (tons) for the modeling domain. From U.S. Environmental Protection Agency (2022c), Table 5-7.

Sector	2016fj	2023fj	2026fj	2032fj
airports	56,300	64,779	67,546	73,465
cmv_c1c2_12	90,624	64,719	56,294	47,300
cmv_c3_12	264,816	277,635	287,826	300,207
nonpt	193,886	196,857	198,442	195,724
nonroad	566,188	377,891	334,265	284,630
np_oilgas	239,247	244,056	238,015	224,204
onroad	1,341,526	650,732	523,684	387,755
onroad_ca_adj	99,730	48,303	44,880	41,490
pt_oilgas	175,250	189,944	192,640	189,043
ptagfire	3,193	3,193	3,193	3,193
ptegu	605,014	264,200	239,930	265,088
ptnonipm	391,374	381,066	386,919	385,113
rail	236,771	198,559	186,854	176,801
rwc	4,280	4,528	4,596	4,601
Total U.S. Anthro	**4,268,199**	**2,966,463**	**2,765,084**	**2,578,614**
beis	587,057	587,057	587,057	587,057
ptfire-rx	20,531	20,531	20,531	20,531
ptfire-wild	55,500	55,500	55,500	55,500
Grand Total	**4,931,288**	**3,629,551**	**3,428,173**	**3,241,702**

[8] IPM is a model that accounts for variables and information such as energy demand, planned unit retirements, and planned rules to forecast unit-level energy production and configurations. EPA used IPM outputs from the Summer 2021 version of the IPM platform (see https://www.epa.gov/airmarkets/epas-power-sector-modeling-platform-v6-using-ipm-summer-2021-reference-case; https://www.epa.gov/power-sector-modeling/documentation-epas-power-sector-modeling-platform-v6-summer-2021-reference).

Table A-2. Summary of national ozone season VOC emissions by source sector (tons) for the modeling domain. From U.S. Environmental Protection Agency (2022c), Table 5-8.

Sector	2016fj	2023fj	2026fj	2032fj
airports	24,078	25,745	26,511	28,140
cmv_c1c2_12	3,538	2,476	2,121	1,805
cmv_c3_12	14,553	17,965	19,716	21,943
livestock	156,077	164,112	167,229	170,725
nonpt	344,481	324,891	313,572	305,544
nonroad	573,637	421,807	398,145	383,526
np_oilgas	980,746	979,486	992,390	986,718
onroad	552,899	348,610	293,979	235,488
onroad_ca_adj	44,432	27,229	24,394	19,788
pt_oilgas	114,505	113,824	115,484	115,296
ptagfire	6,314	6,314	6,314	6,314
ptegu	16,215	17,999	18,313	18,934
ptnonipm	248,145	245,742	246,081	245,868
rail	11,039	8,648	7,917	6,674
rwc	36,554	37,983	38,361	38,408
solvents	1,194,840	1,249,563	1,287,153	1,325,357
Total U.S. Anthro	**4,322,053**	**3,992,395**	**3,957,681**	**3,910,526**
beis	20,896,708	20,896,708	20,896,708	20,896,708
ptfire-rx	277,019	277,019	277,019	277,019
ptfire-wild	1,005,261	1,005,261	1,005,261	1,005,261
Grand Total	**26,501,041**	**26,171,383**	**26,136,669**	**26,089,515**

Source Apportionment Tagging

Sonoma Technology worked with the Sierra Club to identify sources and source groups to be tagged for ozone attribution analysis. In total, approximately 500 emission source tags were identified and modeled across multiple simulations. The tagged sources fell into one of the following categories:

- **EGU point sources (~250 tags)**: Coal and natural gas power plants, and in some cases individual units within a facility. Units may be tagged individually, by control equipment, by retirement date, and/or grouped by region.
- **Non-EGU point sources (~150 tags)**: Industrial point sources, tagged individually and/or grouped by state.
- **Transportation**: Onroad mobile sources separated by light and medium and heavy duty vehicle emissions, grouped by state.
- **Building Combustion**: Commercial, institutional, and residential fossil fuel building combustion from the NEI nonpoint sector, grouped by state or ozone nonattainment area. This excludes residential wood combustion.

Meteorology

Meteorological inputs for the CAMx-OSAT simulations were developed by EPA for the 2016 modeling platform using version 3.8 of the Weather Research and Forecasting (WRF) numerical weather prediction model (Skamarock et al., 2008). The meteorological outputs from WRF include hourly varying winds, temperature, moisture, vertical diffusion rates, clouds, and rainfall rates. Selected physics options used in the WRF simulations include the Pleim-Xiu land surface model, Asymmetric Convective Model version 2 planetary boundary layer scheme, Kain-Fritsch cumulus parameterization, Morrison double moment microphysics, and RRTMG longwave and shortwave radiation schemes. Additional details about this WRF simulation and its performance evaluation can be found in U.S. Environmental Protection Agency (2021b).

Initial and Boundary Conditions

Initial and lateral boundary conditions for the 2016v2 modeling platform were developed from three-dimensional global atmospheric chemistry simulations with the Hemispheric version of the Community Multi-scale Air Quality Model (H-CMAQ) version 3.1.1 (Mathur et al., 2017). EPA used an H-CMAQ simulation for 2016 to develop boundary conditions for a CAMx simulation at a horizontal grid resolution of 36 km x 36 km. The outputs from this simulation were used to provide initial and boundary conditions for the 12 km model simulation. OSAT tracks ozone transported through the boundaries, as well as ozone formation resulting from precursor emissions transported through the boundaries.

Post-Processing

The raw result from a CAMx OSAT simulation is hourly ozone contributions from each source tag at each grid cell in the modeling domain for the 2016 ozone season. These hourly contributions were extracted and post-processed for several hundred receptor sites, including ozone monitoring sites as well as locations identified by Sierra Club as environmental justice receptors within ozone nonattainment areas. At each receptor and for each day, the 8-hr average ozone contribution was calculated for each source tag using the averaging period corresponding to the period of highest modeled 8-hr average concentration at the receptor location. Although this analysis approach may not capture the largest ozone contributions modeled during the day, it does reflect contributions during time periods when modeled ozone concentrations are highest. This analysis approach also ensures that ozone contributions from all source tags[9] sum to total modeled 8-hr ozone concentration each day. The post-processed OSAT results along with relevant metadata were compiled into a web-based shinyapps.io dashboard application to facilitate future data mining and analysis.

[9] Including a leftover residual contribution from all untagged sources calculated by CAMx.

OSAT outputs can also be used in a “relative sense” (rather than a “absolute sense”) to apportion an ozone observation (e.g., a monitor concentration or design value) into modeled contributions from individual source tags. One advantage to such an approach is that the modeled contribution can be tied to an observed ozone concentration, rather than tied strictly to a modeled ozone concentration that may be biased. Anchoring the modeled apportionment results to ambient monitoring data can help mitigate uncertainty associated with imperfect model performance (Foley et al., 2015; Jones et al., 2005).

For receptors tied to air quality monitoring sites, ozone contributions were calculated using OSAT results in a “relative sense”. For the base year (2016), relative contribution fractions for each tag on a daily basis were calculated by multiplying the absolute modeled source contribution by the ratio of the monitored MDA8 ozone concentration and the total modeled MDA8 ozone value. For the future year, the ratio of the total modeled MDA8 ozone concentration between 2023 and 2016 is used to estimate projected future year (2023) observed ozone concentrations, and this projected observed ozone is used to apportion the modeled ozone. These approaches have been used in past ozone source apportionment modeling analyses (e.g., Craig et al., 2020) and are similar to methods used by EPA to calculate ozone source contributions from a photochemical grid model (U.S. Environmental Protection Agency, 2022b).

Model Performance Evaluation

EPA evaluated its 2016 modeling platform using statistical assessments of modeled ozone predictions versus observations paired in time and space. A summary of model performance statistics from the 2016v2 platform is shown in **Table A-3**. Generally, the modeling platform underpredicts MDA8 ozone concentrations for days when the MDA8 ozone is greater than or equal to 60 ppb. But overall, EPA found that “the ozone model performance results for the CAMx 2016fj (2016v2) simulation are within or close to the ranges found in other recent peer-reviewed applications (e.g., Simon et al., 2012 and Emery et al., 2017)” and that “the model performance results demonstrate the scientific credibility of the 2016v2 modeling platform.” Additional details on the ozone model performance evaluation for EPA’s 2016v2 platform can be found in the Technical Support Document (TSD) for the modeling platform (U.S. Environmental Protection Agency, 2022b).

Table A-3. Summary of ozone model performance statistics from the EPA 2016v2 modeling platform for days with MDA8 ozone ≥ 60 ppb for the period May through September. 'MB' is mean bias, 'ME' is mean error, 'NMB' is normalized mean bias, and 'NME' is normalized mean error. From U.S. Environmental Protection Agency (2022c), Table A-3.

Climate Region	Number of Site-Days ≥ 60 ppb	MB (ppb)	ME (ppb)	NMB (%)	NME (%)
Northeast	2997	-4.1	7.1	-6.2	10.7
Ohio Valley	3211	-7.1	8.7	-10.9	13.3
Midwest	1134	-12.7	13.0	-19.1	19.5
Southeast	1477	-2.9	6.1	-4.5	9.4
South	993	-7.8	9.1	-12.0	14.1
Southwest	3054	-8.8	9.7	-13.6	15.1
Northern Rockies	215	-11.9	12.4	-19.0	19.8
Northwest	84	-5.8	10.8	-9.0	16.6
West	8279	-9.7	11.4	-13.8	16.2

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