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Illinois Pollution Control Board
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2520 W Iles Ave
Springfield, IL 62702

Submitted via email to Clerk Don Brown (Don.Brown@illinois.gov)

Re: Proposed Clean Car and Truck Standards (R2024-017)

To the members of the Pollution Control Board:

My name is Daniel E. Horton, and I am an associate professor at Northwestern University, where I lead the Climate Change Research Group in the Department of Earth and Planetary Sciences. I testified before the Board earlier in this proceeding as a witness for the Rule Proponents, wherein I urged the Board to adopt the Advanced Clean Cars II (ACC II), Advanced Clean Trucks (ACT), and Heavy-Duty Low NO_x Omnibus (Low NO_x) Rules (the "Proposed Rules"). As I explained before, my research examines, among other things, atmospheric modeling, air quality, and the public health benefits of electric vehicle adoption, particularly medium-duty vehicles (MDVs) and heavy-duty vehicles (HDVs) (together, MHDVs).

My previous testimony in this matter summarized my ongoing research relevant to the Proposed Rules and directed attention to my studies that had been published as of September 16th, 2024 – the date my prefiled testimony was submitted to the Board. In that testimony, I described aspects of the current state of air quality in Illinois and focused on how vehicle emissions contribute to pollution in high-density areas, disproportionately impacting communities of color. I also provided relevant research that I've conducted, including detailed NO_x pollution analysis based on high-resolution atmospheric modeling using the EPA-developed WRF-CMAQ model.[1] With this model, we simulate pollutant concentrations such as NO_2, $PM_{2.5}$, and O_3 with fine spatial and temporal detail and assess neighborhood-level disparities in pollution exposure across Illinois.[2]

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[1] Rule Proponents' Pre-Filed Testimony at 106-07.
[2] Rule Proponents' Pre-Filed Testimony at 106.

This research has consistently revealed elevated pollutant levels along major roadways and in predominantly Black and Latino communities.[3] Since over 60% of the population tracts with the highest NO_2 exposure are predominantly Black,[4] the health benefits related to reducing NO_2 exposure would be especially great in nonwhite communities. In fact, my research projected that even a 30% transition to electric HDVs could prevent *hundreds* of premature deaths annually while reducing air pollution disparities among population subgroups.[5] These findings support the urgency and potential effectiveness of the Proposed Rules in advancing environmental justice and public health in Illinois.

Today, I write to update you on my latest study – one which not only reiterates the deleterious health effects associated with NO_2 emissions from motor vehicles, but also demonstrates the incredible public health benefits that these Proposed Rules, specifically the ACT, could achieve in Illinois. This study, "Assessing the air quality, public health, and equity implications of an Advanced Clean Trucks policy for Illinois," was published on March 18th, 2025, in *Frontiers of Earth Science* – a multidisciplinary, peer-reviewed journal – after undergoing the peer review process.

Our most recent study yet again demonstrates that policies which reduce transportation emissions provide dual benefits by lowering both greenhouse gases like CO_2 and harmful local air pollutants such as NO_2, leading to dramatic improvements in public health. I understand that the Board has heard illustrative stories from numerous other commenters about the health struggles that result from polluted air, and **my research quantifies the change that adopting the Proposed Rules could achieve: implementing the ACT regulation in Illinois would prevent *hundreds* of premature deaths and asthma cases annually.**

To highlight some specific findings from my recent study:

- Medium and heavy-duty vehicle emissions account for roughly 22% of NO_2 emissions in the Chicago area.[6]
- Annually, NO_2 exposure from medium and heavy-duty vehicles is associated with 1330 premature deaths and 1580 new cases of pediatric asthma in the Chicago area alone.[7]
- If ACT went into effect today, Illinois would see 500 fewer premature deaths and 600 fewer new pediatric asthma cases annually due to the lower exposure of Illinoisians to NO_2.[8]

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[3] Rule Proponents' Pre-Filed Testimony at 108.
[4] Rule Proponents' Pre-Filed Testimony at 110.
[5] Rule Proponents' Pre-Filed Testimony at 111.
[6] Lang et al., *Assessing the air quality, public health, and equity implications of an Advanced Clean Trucks policy for Illinois*, Front. Earth Sci (2025) at 1 (*attached below*).
[7] Lang et al., *supra* note 5, at 1.
[8] Lang et al., *supra* note 5, at 1.

Furthermore, the benefits from adopting ACT in Illinois described by my new study would be greatest in communities of color, where vehicle pollution is most concentrated. Since high MHDV activity is often found in census tracts with predominantly nonwhite populations, reductions in MHDV emissions are especially damaging in nonwhite communities.[9] For example, trucking hubs like warehouses, which can experience up to 30,000 truck trips daily, are 195% more likely to be located in predominately Latino and Hispanic communities than other demographic areas.[10] As a result, these communities experience significantly higher rates of premature deaths and pediatric asthma compared to areas with lower pollution exposure, which are disproportionately white.

This research further indirectly indicates that reductions in NO_x pollution due to adoption of the Low NO_x rule would have incredible health benefits for Illinoisians, even though this study evaluated specifically ACT adoption in Illinois. My new study broadly serves to highlight the disparate health impacts created by vehicle-created NO_x pollution in Illinois communities – a problem which any reduction in NO_x would help mitigate. My recent article thus underscores a constant conclusion from my ongoing research: increased regulatory stringency in vehicle emission standards for NO_x and other hazardous pollutants in Illinois would improve clean air equity, address disparate impacts in air pollution, and ultimately, save lives.

In conclusion, adopting the Proposed Rules is a vital step toward cleaner air and healthier communities in Illinois. As highlighted by my most recent study, my research continues to demonstrate that vehicle emissions policies such as the Proposed Rules would prevent hundreds of premature deaths and pediatric asthma cases annually, with the greatest benefits in overburdened communities. Strengthening vehicle emissions standards, and thereby reducing air pollution, is critical to advancing environmental justice and protecting the health of Illinoisians. Thank you for your work in making Illinois a cleaner, safer place for all.

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[9] Lang et al., *supra* note 5, at 10..
[10] Lang et al., *supra* note 5, at 3.

Front. Earth Sci.
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RESEARCH ARTICLE

Assessing the air quality, public health, and equity implications of an Advanced Clean Trucks policy for Illinois

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Abstract Policies designed to reduce transportation emissions are known to be co-beneficial due to reductions in planet-warming greenhouse gases like carbon dioxide (CO_2) and health-harmful air pollutants, such as nitrogen dioxide (NO_2). The growing recognition of persistent racial and ethnic disparities in air pollution exposure and associated health impacts has increased demand for policy interventions aimed at systematically reducing such inequities. Here, we use a regulatory-grade air quality model focused on the Chicago region to find that medium- and heavy-duty vehicle (MHDV) tailpipe emissions account for ~22% of the area's ambient NO_2 concentrations. Exposure to MHDV-tailpipe NO_2 in our domain is associated with 1330 (95% confidence interval (CI): 330, 2000) annual premature deaths and 1580 (95% CI: −310, 3870) new cases of pediatric asthma, disproportionately affecting census tracts with higher percentages of residents of color. Given the inequitable impacts of MHDV NO_2 exposure, we also use our model to assess the air quality, health, and equity outcomes if a policy scenario based on California's Advanced Clean Trucks (ACT) regulation were instantaneously adopted in Illinois. We find that ACT adoption would lead to ~48% of on-road MHDVs having zero tailpipe emissions by 2050; an instantaneous transition to this policy would reduce annual mean population-weighted NO_2 concentrations by 0.98 ppb (parts per billion) (−8.4%), resulting in reductions of 500 (95% CI: −120, −750) premature deaths and 600 (95% CI: 120, −1440) fewer new pediatric asthma cases annually – with the largest health benefits observed in neighborhoods with higher percentages of residents of color. Our study highlights the benefits of implementing policy interventions focused on zero-emission MHDVs to address air pollution exposure and health impact disparities.

Keywords zero-emission vehicles, transportation, air pollution, public health, environmental justice

1 Introduction

The disproportionate impacts of traffic-related air pollution on historically marginalized U.S. population subgroups underscores the potential for policy interventions that target transport emissions to advance environmental justice objectives and enhance public health outcomes (Chambliss et al., 2021; Demetillo et al., 2021; Kerr et al., 2021). Nearly a quarter of the U.S. population resides within 500 m of high-volume roadways, with people of color disproportionately exposed to traffic (Antonczak et al., 2023). Within the U.S., the on-road transportation sector contributes ~29% of both the nation's greenhouse gas and nitrogen oxide emissions. Nitrogen oxide emissions (NO_x; NO_2 + NO) include primary health-harmful pollutants like NO_2 and precursors that contribute to the formation of secondary health-harmful pollutants, such as tropospheric ozone (O_3) and fine particulate matter ($PM_{2.5}$). Despite comprising less than 10% of on-road vehicles (Environmental Defense Fund, 2021), medium- and heavy-duty vehicles (MHDVs) contribute ~23% and 31% of on-road greenhouse gas and NO_x emissions, respectively (US Environmental Protection Agency, 2017, 2021a).

Exposure to traffic-related primary and secondary pollutants is associated with a myriad of substantial

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negative health outcomes (HEI, 2022). Exposure to traffic-related NO_2 has been implicated in pediatric asthma incidence (Khreis et al., 2017), with global NO_2 pollution estimated to contribute to 1.85 million new pediatric asthma cases annually (Anenberg et al., 2022). Ethnic and racial disparities are evident in the distribution of NO_2 pollution concentrations, with people of color experiencing concentrations 15%−50% higher than the U.S. average (Kerr et al., 2023). Additionally, there is growing confidence in the linkages between NO_2 exposure and premature mortality (Huangfu and Atkinson, 2020; HEI, 2022). As a result of this growing confidence, researchers have recently estimated annual U.S. NO_2-attributable premature mortality to be ~170850 premature deaths per year (Camilleri et al., 2023a). Given that NO_2 exposure is disproportionately higher among marginalized populations, premature mortality attributable to NO_2 exposure has also been found to be elevated among population subgroups. For example, Camilleri et al. (2023a) found that NO_2-attributable mortality rates among the U.S. Black population were 47% higher than the continental U.S. average. Premature deaths have also been linked to traffic-related O_3 and $PM_{2.5}$ exposure (Davidson et al., 2020), with 43% of these deaths attributed to on-road diesel vehicle emissions (Anenberg et al., 2019). Given emerging confidence in the health-harming impacts of traffic-related NO_2 and the well-established health-harmful linkage to O_3, here we evaluate how a policy intervention aimed at transitioning MHDVs to zero-emission vehicles alters NO_2 and O_3 concentrations, and assess the population exposure, health outcomes, and associated environmental equity implications.

Previously adopted air quality remediation interventions range from emissions testing (CARB, 2021) to emission control technology mandates (U.S. Environmental Protection Agency, 2021a) to incentives promoting electric passenger car and truck adoption (The White House, 2023). While these efforts have contributed to an overall improvement in U.S. air quality, relative racial and ethnic disparities in exposure and health outcomes persist, and in some cases, have increased. For example, from 2010 to 2019, relative racial disparities in $PM_{2.5}$-attributable mortality and NO_2-attributable pediatric asthma have grown in the U.S. (Polonik et al., 2023; Kerr et al., 2024b). This growing recognition of persistent relative racial disparities has increased demand for policy interventions aimed at systematically reducing inequities (Wang et al., 2023). Among these, Polonik et al. (2023) suggested that policy interventions focused on the transportation sector had the greatest potential to reverse disparities in exposure. However, a recent California-focused study found that while aggressive vehicle emission control policies had reduced average statewide exposures to $PM_{2.5}$, relative exposure disparities for people of color had increased (Koolik et al., 2024). Koolik et al. concluded that reducing the inequitable relative exposure to vehicle emissions ultimately requires policies addressing the disproportionate geographical distribution of emissions in overburdened communities. These findings underscore that broad, sector-wide emission reductions alone are insufficient to address inequities in transportation-related pollution. Instead, targeted policies (e.g., low emission zones, incentives for heavy-duty electrification, etc.) that prioritize emission reductions in historically over-burdened communities are more effective in mitigating racial disparities (Camilleri et al. 2023b; Polonik et al., 2023).

Calls for policies that target unjust exposure and health disparities are often led by community members and non-profit organizations that represent residents who are most impacted by exposure and health injustices. In the state of Illinois, the Neighbors for an Equitable Transition to Zero-Emissions (NET-Z) coalition have worked to reduce diesel pollution in communities across the state and have recently advocated for the state to implement an Advanced Clean Trucks (ACT) policy. This policy, initially implemented in California, would require manufacturers to gradually increase the proportion of zero-emission MHDVs sold in Illinois. Because this policy targets MHDVs, which predominantly operate along major roadways, it could offer a potential solution to reducing observed disparities in traffic-related air pollution exposure. As a result, this study was designed to simulate the potential benefits of Illinois adopting an ACT policy while also demonstrating the effectiveness of collaboration between scientists and local advocacy groups, such that the collaboratively agreed-upon experimental design aligned scientific research objectives with the questions and priorities of community members, for greater policy impact.

To assess the efficacy of policy interventions in reducing air pollution exposure and associated health injustices, pollutants must be accurately characterized at spatial resolutions that facilitate differential exposure and susceptibility estimates among population subgroups. This is particularly true in urban settings where pollutant gradients can be steep (Levy et al., 2014; Apte et al., 2017; Montgomery et al., 2023a), marginalized populations are prevalent, and geographic segregation due to systemically racist policies persists (e.g., redlining, chronic disinvestment) (Mohegh et al., 2021; Lane et al., 2022). Prior research has demonstrated that impact- and equity-focused assessments should resolve pollutants at ~1 km or finer scales, due to an underestimation of impacts when assessments are conducted at a coarser resolution (Mohegh et al., 2021; Clark et al., 2022). Similarly, using coarse resolution (e.g., county- or state-level) baseline disease rates in health impact assessments can substantially underestimate true health impacts when compared with estimates that use health and demographic data at finer spatial scales (e.g., census tract-level) (Southerland et al., 2021; deSouza et al., 2024).

Advances in computational power and the availability of high-resolution emission data sets have enabled the use of Chemical Transport Models (CTMs) for assessments of air pollution exposure (Zhang et al., 2014) and remediation strategies at enhanced resolutions (Liang et al., 2019; Schnell et al., 2019). For our purposes, a high-resolution CTM refers to a model capable of resolving pollutant concentrations at spatial scales of ~1 km or finer, as models with this level of resolution are effective in capturing air pollution disparities. Recent studies have highlighted the effectiveness of using high-resolution CTMs to simulate electric vehicle adoption, focusing their analyses on the associated impacts on air quality (e.g., Li et al., 2016) and health (e.g., Pan et al., 2019; Gai et al., 2020; Mousavinezhad et al., 2024). However, only a few have leveraged their high-resolution CTM simulations to assess the overall equity implications (e.g., Camilleri et al., 2023b; Visa et al., 2023). Unlike prior studies, which often rely on arbitrary or generalized zero-emission vehicle adoption rates to estimate impacts, this study simulates a targeted zero-emission vehicle adoption policy designed with community-aligned real-world policy goals. This approach provides a more actionable and policy-relevant framework for evaluating impacts on exposure, health, and equity in Illinois, enhancing its utility for understanding policy outcomes and supporting policy advocacy.

In consultation with NET-Z coalition members, we designed a study that uses a regulatory-grade CTM to quantify the air quality and health impacts of MHDV emissions. Here, regulatory-grade CTM refers to the WRF-CMAQ model used by the U.S. EPA to support environmental policy decisions. This model is designed to meet rigorous scientific and regulatory standards, ensuring state-of-the-science simulations of air quality and pollutant dispersion. We then assess the effectiveness of an ACT policy scenario to reduce MHDV-related pollutant concentrations and health impacts in the Greater Chicago region. Projected MHDV sales and fleet turnover were modeled through 2050, assuming ACT implementation starts in 2027 and zero-emission vehicle energy demands would be met by renewable sources. Census-tract health and demographic data are then used to estimate the potential health benefits of the ACT as well as constrain equity outcomes. Our analysis is centered on the Greater Chicago region (Cook, DuPage, Kane, Kendall, Lake, McHenry, Will Counties), which is recognized as a substantial freight hub, attracting 53% of Illinois' MHDV vehicle miles traveled (Eyth et al., 2022). This region is home to a diverse population of 8.5 million residents, representing approximately 68.5% of Illinois' total population (Manson et al., 2023). Our results provide critical information for policymakers, environmental advocates, and public health practitioners striving to address the disproportionate burden of transportation-related air pollution on marginalized communities.

2 Methods

The below-described methodology grew out of a dialog between NET-Z coalition members and academic researchers at Northwestern University that was facilitated by the Environmental Defense Fund (EDF). The Northwestern Researchers had recently published a manuscript detailing the Air quality, health and equity implications of electrifying heavy-duty vehicles (Camilleri et al., 2023b). EDF thought the results of the paper and its press release (PR) could be helpful to share with local environmental justice groups participating in the NET-Z coalition. EDF staff helped organize a virtual Zoom-based briefing for NET-Z members from Northwestern researchers on the Camilleri et al. findings and subsequent additional analyses, and assisted with the preparation of an approachable 2-page briefing document that was distributed to the coalition's members, including representatives from the Respiratory Health Association (RHA), Warehouse Workers for Justice (WWJ), and Little Village Environmental Justice Organization (LVEJO). During the briefing, and in a subsequent follow-up Zoom meeting, NET-Z members provided feedback on the published Northwestern study. Specifically, the coalition members criticized Camilleri et al. (2023b) for 1) its use of an arbitrary electric vehicle adoption policy as opposed to one of the policies they were lobbying state legislatures to adopt (e.g., ACT) and 2) its use of CTM simulations that underpredict pollutant concentrations on the south-west side of Chicago based on the lived experience of residents. As a result of these criticisms and conversations, the following experiment was co-designed by NET-Z, EDF, and the Northwestern researchers.

Our study domain encompasses the Chicago metropolitan area and its surrounding collar counties (Fig. 1), including Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will Counties, which we henceforth refer to as the Greater Chicago region. The Chicago Metropolitan Agency for Planning (CMAP) estimates that in the Greater Chicago region, nearly 1 in 7 vehicles on urban interstates are trucks and that ~25% of all freight trains and 50% of intermodal trains in the U.S. pass through the area (CMAP, 2017). This substantial truck and rail activity underscores the region's role as a critical freight hub, which is further evidenced by its high concentration of freight establishments per capita (Cidell, 2010), such as warehouses, which can experience up to 30,000 truck trips daily (CMAP, 2017). Truck traffic associated with the movement of freight has disproportionate impacts, as warehousing in Illinois is

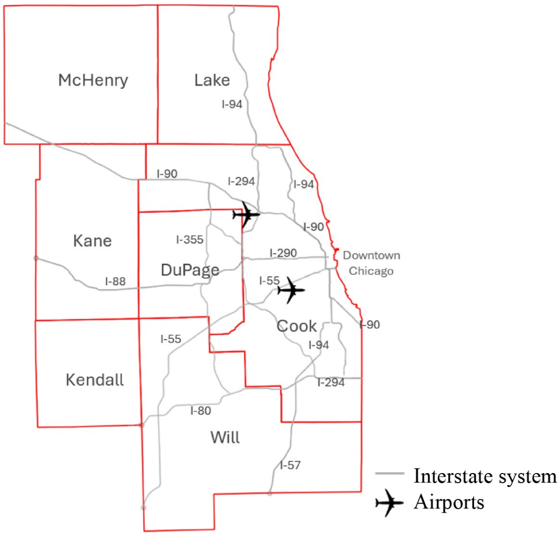

Fig. 1 The study domain encompasses the Chicago metropolitan area and its surrounding collar counties, including Cook (location of Chicago, IL), DuPage, Kane, Kendall, Lake, McHenry, and Will Counties.

195% more likely to be situated in Hispanic or Latino neighborhoods (Environmental Defense Fund, 2024). Consequently, truck traffic in this region has sparked concerns raised by Chicago-based community groups (e.g., LVEJO, WWJ), particularly regarding its disproportionate impact on local environmental justice communities (WWJ, 2023; Lippert, 2024). In 2023, the deployment of 35 truck-counting cameras throughout Chicago revealed that communities along I-55, southwest of downtown, frequently experience thousands of truck passages daily in predominantly non-white neighborhoods (Center for Neighborhood Technology, 2024). With over half of the state's population residing within the Greater Chicago region, this area offers a crucial opportunity to understand how targeted MHDV policy interventions can effectively address urban air pollution and current environmental justice issues.

2.1 Air quality modeling

To quantify the impact of MHDV emissions and assess the policy benefits and tradeoffs of an ACT policy adoption scenario in Illinois, we simulate changes in air pollutants as a result of two zero-emission MDHV adoption scenarios using the two-way coupled Community Multi-scale Air Quality (CMAQ, v5.2 (Byun and Schere, 2006)) and Weather Research and Forecasting (WRF, v3.8 (Skamarock et al., 2008)) modeling platform (WRF-CMAQ (Wong et al., 2012)). Using a nested modeling framework, within our innermost high-resolution domain we simulate air pollutant concentrations at a 1.3 km^2 horizontal spatial resolution over a midwestern domain centered on southern Lake Michigan, encompassing the Greater Chicago region. Due to computational expense, meteorological conditions were simulated for one month within each meteorological season, specifically August and October 2018, and January and April 2019. Our meteorological modeling framework and evaluation are outlined in detail in Montgomery et al. (2023b). Monthly simulations for baseline (i.e., simulations where the magnitude of vehicle emissions are not modified) and zero-emission MHDV adoption scenarios were then averaged to approximate annualized mean conditions, aligned with methods employed by previous research (Peng et al., 2021; Torbatian et al., 2024).

Simulated emissions are developed using the EPA's Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system, version 2016 V2 (Eyth et al., 2022). This emission data set is developed using the EPA's Motor Vehicle Emission Simulator (MOVES) version 3 and the 2017 NEI (version 2016fj), which is projected back one year. The SMOKE modeling platform incorporates MOVES to generate hourly, gridded, and meteorologically informed emissions through the combination of county-specific emission factors with traffic activity data (e.g., vehicle miles traveled, hours of idling activity, etc.), meteorological data (e.g., ambient temperature and humidity from WRF-CMAQ), and other ancillary data, such as speed distributions (Eyth et al., 2022). This modeling framework simulates vehicle processes such as running exhaust, start exhaust, brake wear, tire wear, evaporative emissions, crankcase exhaust, refueling vapor emissions, extended idle exhaust from long-haul combination trucks (i.e., hotelling), and the recent addition of off-network idling (ONI) exhaust (U.S. Environmental Protection Agency, 2021b; Eyth et al., 2022). The recent addition of ONI is meant to account for emissions resulting from vehicles idling off roadways for less than one hour, such as vehicles idling in driveways, pick-up lines, or during loading and unloading of freight. In MOVES vehicle emission processes are categorized into six groups: rate-per-distance, rate-per-vehicle, rate-per-profile, rate-per-hour, rate-per-hour-oni, and rate-per-start, taking into consideration vehicle fleet characteristics such as vehicle make, model, and age, road type, and fuel properties (Eyth et al., 2022).

County-level emissions are spatially distributed to uniform grids using spatial surrogates, which quantify the proportion of a geographic attribute within a grid cell relative to the corresponding attribute's areal extent across a given county. Highly resolved spatial surrogates used to spatially distribute emissions were developed by the Lake Michigan Air Directors Consortium (LADCO, 2022). The default spatial surrogate used to distribute ONI emissions in SMOKE is based on the National Land Cover Database's medium and high development intensity classification, which includes areas with a mix of constructed materials and vegetation, or highly developed areas where large numbers of people reside or work. This spatial distribution reasonably represents ONI activity for light-duty vehicle types but does not adequately capture the localized idling activity of MHDVs, which often idle at warehouses, distribution centers, ports, railyards, intermodal facilities, and feeder roads. Recent satellite observations have detected elevated levels of NO_2 pollution downwind of areas with dense warehousing, a feature that is not currently captured by the U.S. EPA's emission inventory (Goldberg et al., 2024; Kerr et al., 2024a). Therefore, as a first step to augment the spatial distribution of MHDV emissions, three-fourths of ONI emissions from specific MHDVs (i.e., single-unit short- and long-haul trucks, and combination short- and long-haul trucks) are allocated to warehouse locations utilizing data from the Commercial Real Estate Market Analytics (CoStar). Within the SMOKE modeling platform, emissions from on-road, point, and area sources are generated, whereas biogenic emissions, lightning emissions, and windblown dust are calculated within CMAQ.

Baseline simulations were evaluated following the EPA recommendations (Dennis et al., 2010), using an operational evaluation by comparing hourly model performance with EPA surface observations. Within the model domain, baseline WRF-CMAQ simulations of average hourly NO_2 and O_3 are well correlated with EPA surface observations (r > 0.6), with an average normalized mean bias (NMB) of −6.79% and 32.13%, respectively (Appendix A1). While there are no set benchmarks for photochemical modeling in the U.S., our model performance of NMB and Pearson correlation coefficients (r) are aligned with other previously published Midwestern-focused WRF-CMAQ modeling studies (Bickford et al., 2014; Montgomery et al., 2023b).

To assess the overall impact of MHDV emissions on air quality, we design one scenario that eliminates all MHDV tailpipe emissions from the existing on-road MHDV fleet within the regulatory-grade model (Table 1). We define MHDVs as the Federal Highway Administration's Highway Performance Monitoring System (HPMS) vehicle Class 2b and higher. Given our modeling framework, the HPMS MHDV classifications do not directly map to MOVES vehicle classifications. Therefore, HPMS MHDV classification were aligned with MOVES definitions by incorporating the regulatory class coverage adjustments from MOVES, which provided national estimates of the composition of MOVES vehicle types when converting from the HPMS classifications (U.S. Environmental Protection Agency, 2021b). For example, for MOVES's vehicle class "Light Commercial Truck," only 24.74% falls under the MHDV classification (i.e., Class 2b and higher). Therefore, we modified MOVES emission factor tables to reflect zero tailpipe emissions for 24.7% of the MOVES Light Commercial Truck vehicle class. Emission factors for brake and tire wear processes were not modified. We assessed the difference in annualized population-weighted mean pollutant concentrations between our simulation in which all tailpipe emissions from MHDVs are removed and the baseline, attributing the difference in air pollution concentrations to MHDV-related traffic activity. Annualized concentrations were calculated by averaging results from the four simulated months—August and October 2018, and January and April 2019—representing one month from each meteorological season.

For our ACT policy adoption scenario, we simulated an instantaneous transition to zero tailpipe emission MHDVs in proportions aligned with the expected percentage of on-road zero-emission MHDVs in 2050 if Illinois adopted an ACT policy effective in model year 2027 (Table 1). Illinois-specific fleet turnover starting with model year 2027 was calculated following the methodology of Robo et al. (2022), in which future fleet turnover is estimated based on historical average turnover rates and projected sales of MHDVs through 2050. Using this approach, we estimated the percentage of on-road zero-emission MHDVs in 2050 to be 46% of Class 2b vehicles, 47% of Class 3 vehicles, 65% of buses, 62% of vocational vehicles (such as refuse trucks, motor homes, and single-unit trucks), and 35% of tractor-trailers (Fig. 2(a)). MOVES regulatory class coverage adjustments do not differentiate between Class 2b and Class 3. Consequently, we adjusted emission reductions from these two classes by averaging their corresponding projected fleet turnover, resulting in a reduction of 46.5%. By 2050, the largest number of zero-emission MHDVs in the Greater Chicago region will be Class 2b/3

Table 1 Sensitivity simulations comparing baseline, 100% MHDV scenario, and ACT adoption in Illinois, highlighting modifications to emissions and spatial distribution of off-network idling (ONI) emissions

Item	Scenario		
	Baseline	100% MHDV	ACT Adoption in IL
Emission changes	No modifications	100% of tailpipe emissions from MHDVs removed	Tailpipe emission reductions per class: Class 2b&3: 46.5% Buses: 65% Vocational: 62% Tractor-trailers: 35%
Spatial distribution of ONI emissions	75% of ONI MHDV emissions assigned to grid cells containing warehouses	Same as baseline	Same as baseline

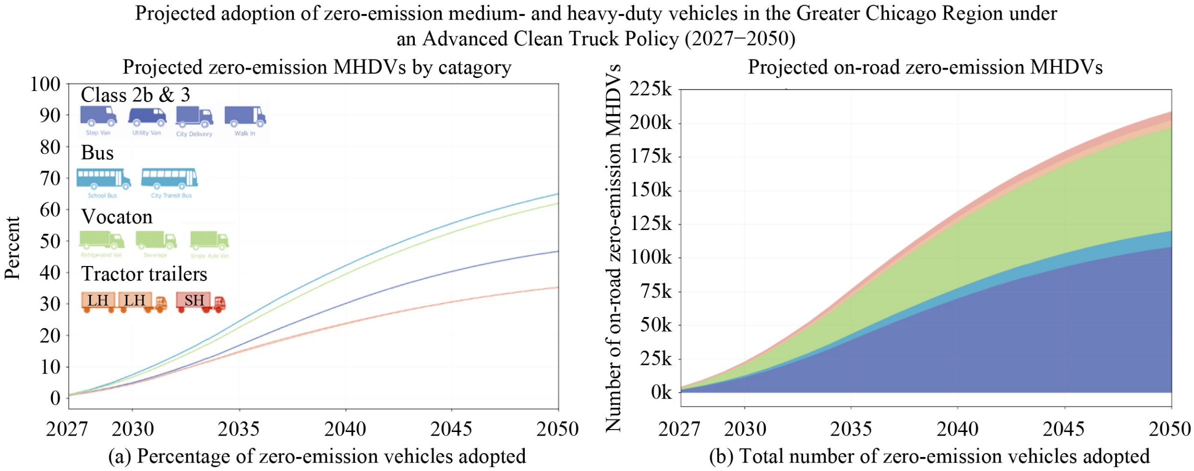

Fig. 2 (a) Estimated percent of on-road zero-emission MHDVs and (b) total number of on-road zero-emission MHDVs in the Greater Chicago region as a result of modeled Advanced Clean Trucks policy adoption in Illinois beginning with model year 2027 and projected through 2050. The legend includes examples of vehicles within each class.

vehicles, totaling over 108000 vehicles, followed by vocational vehicles which will number over 76000 vehicles (Fig. 2(b)). We modified MOVES emission factor tables, scaling reductions based on the zero-emission MHDV projections and the regulatory class coverage adjustments, assuming current vehicle demographics and technology. Given ongoing efforts to decarbonize the electricity grid, the supplemental energy required for zero-emission vehicles in this policy scenario is presumed to originate from renewable sources. We posit that this assumption is reasonable given that in 2021, Illinois signed the Climate and Equitable Jobs Act which targets a transition to 100% renewable energy by 2050 (Climate and Equitable Jobs Act, 2021). While not all energy production occurs in Illinois, previous EV adoption analyses revealed only marginal effects when additional electricity generation unit emissions are accounted for within the CTM domain (Visa et al., 2023)

2.2 Health impact analyses

Using differences in census tract-level air pollutant concentrations between CTM sensitivity simulations and the baseline (Δx), we assessed the potential health benefits/tradeoffs of the MHDV transitions described above. Specifically, we estimate the NO_2 and O_3 attributable premature mortality and NO_2 attributable pediatric asthma incidence using Eqs. (1) and (2):

$$\mathrm{AF_{ct}} = 1 - \mathrm{e}^{(-\beta \Delta x_{\mathrm{ct}})}, \tag{1}$$

$$\mathrm{Mort_{ct}} = \mathrm{BMR_{ct}} \times \mathrm{POP_{ct}} \times \mathrm{AF_{ct}}. \tag{2}$$

We first estimated the fraction of the underlying health outcome attributable to air pollution exposure, i.e., the attributable fraction (AF), following Eq. (1). Census tract-level air pollution concentrations were determined by calculating the area average of the intersection between grid cell-level simulated pollutant concentrations and census tract polygons using the GeoPandas package (Jordahl et al., 2021). β coefficients for each pollutant and health outcome were derived from relative risks (RRs) calculated in previous peer-reviewed epidemiological studies. We estimated the annual premature all-cause mortality associated with long-term exposure to NO_2 for people over 30 years using a relative risk (RR) of 1.04 (95% CI 1.01–1.06) per 10 $\mu g/m^3$ converted to ppb (parts per billion) equivalent (HEI, 2022) and a RR of 1.02 (95% CI 1.01–1.04) (Turner et al., 2016) per 10 ppb was used to estimate the all-cause mortality associated with long-term exposure to daily maximum 8-h running mean O_3 (MDA8 O_3). Lastly, NO_2-attributable pediatric asthma incidence (new cases annually) was estimated using an HEI-derived RR of 1.05 (95% CI 0.99–1.12) per 10 $\mu g/m^3$ (HEI, 2022) for children under the age of 18.

For each census tract, the annual all-cause air pollution attributable deaths were then calculated by multiplying the census-tract level AF from Eq. (1) by the baseline mortality rate (BMR) or asthma incidence and the population (POP) within each census tract (ct; Eq. (2)). We leverage high-resolution all-cause BMRs at the census tract level, stratified by 5-year age groups and derived from USALEEP abridged life tables with modifications for broader use in national health benefits analyses (Raich et al., 2020). BMRs represent the time period 2010–2015. Census-tract level demographic data of race and ethnicity was collected from the U.S. Census Bureau 2015–2019 American Community Survey (ACS; accessed by the National Historical Geographic Information System) (Manson et al., 2023). Given the lack of high-resolution asthma incidence rates, here we used annual state-level asthma incidence rates for 2019, stratified by 5-year age group from the Global Burden Disease Study from 2019 (Murray et al., 2020). Given the underlying differences in methodologies used to derive the different RRs, such as adjusting for confounding factors, we report air pollution attributable health impacts for each pollutant separately.

3 Results

3.1 Impact of zero-emission MHDV adoption policy on NO_2

To assess the impacts of zero-emission MHDV adoption scenarios in Illinois, we simulate (i) baseline conditions, (ii) instantaneous elimination of all MHDV tailpipe emissions, and (iii) instantaneous transition to the proportion of zero tailpipe emission MHDVs that could be achieved by 2050 with adoption of an ACT new vehicle sales targets starting in model year 2027 (see Section 2). In the baseline simulations, annual population-weighted mean NO_2 concentrations are 11.7 ppb, with concentrations exceeding 25 ppb within the urban core of Chicago, near airports (i.e., O'Hare International and Chicago Midway), and along interstate highways that feed into the city (Fig. 3(a)). Outside of Cook County, home of Chicago, simulated NO_2 concentrations are generally less than 8 ppb, with the exception of city centers and primary trucking routes, e.g., I-294, I-80, and I-55. We compare our baseline results to those of Montgomery et al. (2023b), as both studies utilize the same meteorological inputs and modeling framework, with the primary methodological difference, the emission modeling platforms used. We

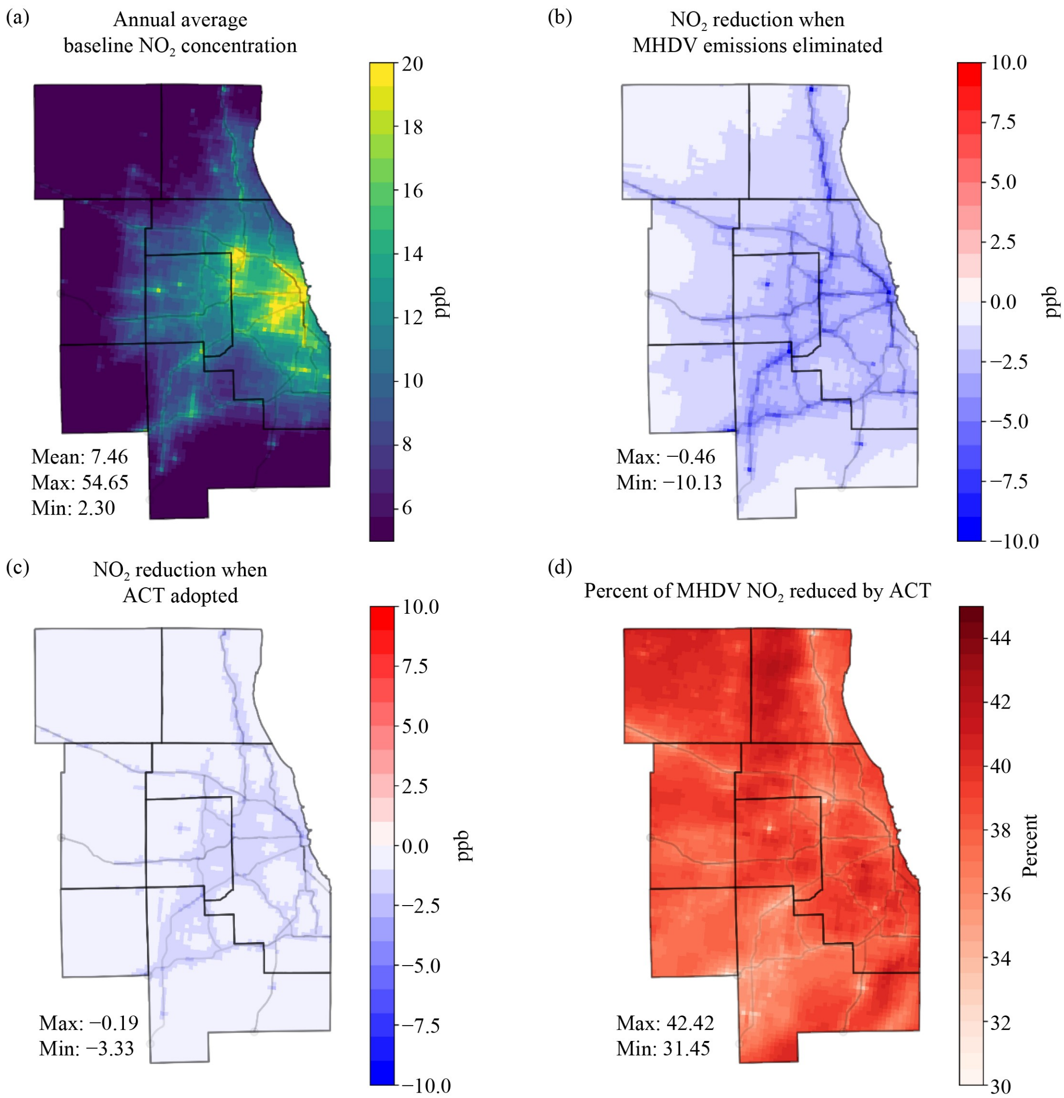

Fig. 3 WRF-CMAQ simulated change in annualized mean (August and October 2018, January and April 2019) NO_2 concentrations for (a) baseline, (b) NO_2 reduction when MHDV emissions are eliminated (100% zero-emission MHDV scenario minus baseline), (c) NO_2 reduction under an Illinois Advanced Clean Trucks (ACT) policy scenario (ACT minus baseline), and (d) percent of MHDV attributable NO_2 reduced by an ACT policy scenario within Illinois over the Greater Chicago region (Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will Counties).

find that locations of elevated NO_2 concentrations in the baseline simulation are similar to those found in Montgomery et al. (2023b). However hot spots near airports were not found in Montgomery et al. (2023b) and are here attributable to the newer emission modeling platform, i.e., SMOKE version 2016V2, which treats airport emissions as two-dimensional pollution sources rather than distributing these emissions vertically along the glide path (Eyth et al., 2022).

To determine where MHDV emissions most impact the Greater Chicago region, we remove MHDV tailpipe emissions from the baseline scenario. We find that in the Greater Chicago region, MHDV emissions contribute to ~22.2% (2.59 ppb) of the domain's annual population-weighted mean NO_2 concentrations, with localized MHDV NO_2 contributions reaching 10.13 ppb (Fig. 3(b)). MHDV pollution is simulated to be most concentrated along primary roadways near downtown Chicago and in the collar counties of Lake and Will. Localized hotspots of MHDV pollution off roadways are particularly notable in central DuPage and Will counties. These hotspots are attributed to truck stops and rest areas where long-haul combination trucks idle extensively during mandated rest periods. MHDV pollution concentrations decrease away from the urban core of Chicago, with local minimum contributions reaching 0.46 ppb in more rural portions of McHenry County.

In our ACT policy simulations, we estimate that ~48% of on-road MHDVs in Illinois will have transitioned to zero-emission vehicles by 2050 (Fig. 2). This shift to zero-emission MHDVs would result in reductions of 0.98 ppb (−8.4%) for annual population-weighted mean NO_2 concentrations, with a local maximum decrease of 3.33 ppb from the baseline simulation (Fig. 3(c)). The largest decreases in NO_2 concentrations are observed along primary roadways, particularly north of downtown Chicago, where MHDV-attributable pollution is highest. The smallest reductions in MHDV pollution occur within the collar counties, with a localized minimum reduction of 0.19 ppb. Overall, the ACT policy scenario leads to localized reductions in MHDV-related NO_2 pollution ranging from 31% to 42% across the Greater Chicago region (Fig. 3(d)). The largest relative percentage reductions occur predominantly away from major roadways, while the lowest percentage changes are observed along primary roadways in Cook, Lake, and Will counties. This pattern occurs because computing relative percentage changes from small absolute concentrations yields larger percentage changes. Truck stops are also identified as regions where the percentage reduction of MHDV-related pollution is ~30%.

3.2 Impact of zero-emission MHDV adoption policy on O_3

The annual population-weighted mean concentration of MDA8 O_3 is 44.32 ppb in the baseline scenario. The highest MDA8 O_3 concentrations occur within Chicago's collar counties, reaching up to 49.32 ppb (Fig. 4(a)). Conversely, the lowest concentrations are observed along primary roadways and within the urban core, with a localized minimum of 20.74 ppb near O'Hare International and Midway Airports. Spatially, MDA8 O_3 concentrations exhibit a clear gradient, transitioning from lower levels in densely populated urban areas to higher levels in the collar counties – highlighting the influence of local emission sources and atmospheric conditions on O_3 formation.

When MHDV tailpipe emissions are removed, we find increases in MDA8 O_3 concentrations, particularly along major road networks (Fig. 4(b)). This phenomenon is primarily due to the reduction of NO_x titration, a process in which NO reacts with hydroxyl radicals or O_3 itself to decrease O_3 concentrations (Isaksen et al., 2009). Without MHDV-related NO_x emissions, less O_3 is destroyed through this reaction. The annual population-weighted mean concentration of MDA8 O_3 is estimated to be 0.83 ppb (1.86%) higher when MHDV tailpipe NO_x emissions are removed, with a maximum simulated local increase of 4.23 ppb. MDA8 O_3 increases from MHDV emissions reductions occur predominantly along interstates and highways, a pattern that is the spatial inverse of where MHDV NO_2 pollution is highest. Rural portions of McHenry County see decreases in MDA8 O_3, while suburban counties of Lake, Kendall, Will, and Kane exhibit regions that experience minimal change in MDA8 O_3 exposure when MHDV emissions are removed.

Similar results are found when simulating ACT policy adoption, albeit to a lesser extent, with rural regions (e.g., McHenry, Kendall, and Kane Counties) experiencing slight decreases (up to −0.08 ppb) or no change in MDA8 O_3 concentrations (Fig. 4(c)). Increases in annual population-weighted mean MDA8 O_3 for the domain were 0.35 ppb, an increase of 0.78% from the baseline simulation, with localized maximum increases up to 1.48 ppb. This observed increase in MDA8 O_3 is consistent with findings from electric vehicle adoption studies, which have also reported increases in ozone concentrations over primary roadways in the Greater Chicago region (Camilleri et al., 2023b; Visa et al., 2023; Mousavinezhad et al., 2024) and beyond (Pan et al., 2019; Peters et al., 2020; Skipper et al., 2023), as well as with earlier work focused on the weekend effect, wherein less weekend traffic in urban environments leads to higher weekend O_3 concentrations than observed on weekdays (Wolff et al., 2013) .

Tropospheric ozone production is influenced by the balance between NO_x and volatile organic compounds (VOCs), with the VOC-NO_x ratio serving as an indicator of whether ozone formation is driven primarily by the availability of VOCs or NO_x. On average for the U.S., the transition from a VOC-limited to a NO_x-limited regime occurs at a VOC:NO_x ratio of ~9.2 (Ashok and Barrett,

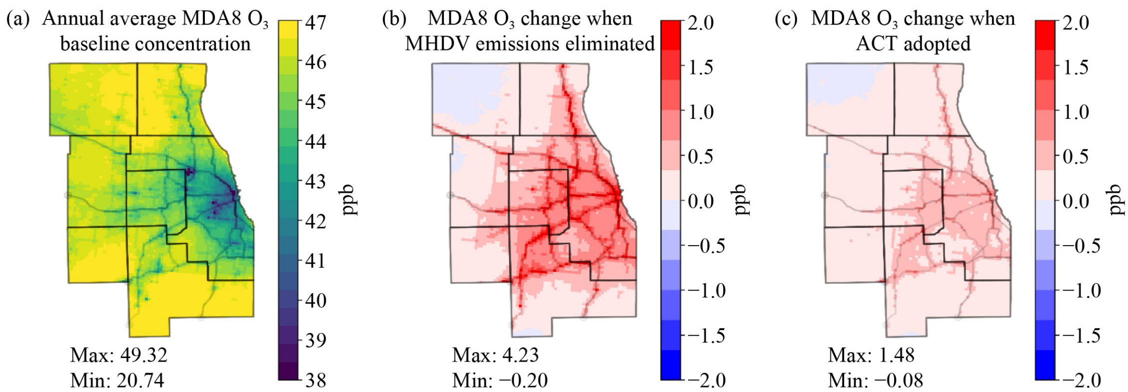

Fig. 4 WRF-CMAQ simulated change in annualized mean (August and October 2018, January and April 2019) MDA8 O_3 concentrations for (a) baseline, (b) difference in MDA8 O_3 between 100% zero-emission MHDV scenario and baseline (100% zero-emission MHDV - baseline), (c) difference in MDA8 O_3 between Illinois Advanced Clean Trucks policy scenario and baseline (ACT - baseline) over the Greater Chicago region (Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will Counties).

2016), but can differ regionally depending on meteorology, emission sources, and VOC constituents (Seinfeld and Pandis, 2016). However, researchers focused on urban environments found that this transition occurs at a ratio of ~6.7 in the Chicago region (Ashok and Barrett, 2016). In our baseline scenario, the annualized mean VOC:NO_x ratio for the Greater Chicago region is 4.75, with localized ratios ranging from 0.83 to 8.55 (Fig. 5(a)). The lowest VOC:NO_x ratios (VOC:NO_x < 4) are simulated within urban areas (e.g., Cook, DuPage Counties) where O_3 concentrations are lowest (Fig. 4), indicating VOC-limited regimes. A transition toward NO_x-limited regimes (VOC:NO_x > 7) is simulated as one moves from urban centers to more rural areas where O_3 concentrations are highest (e.g., northwestern portion of McHenry County, southern portions of Will County). Variations in January, April, and October VOC:NO_x ratio within the Greater Chicago region, with monthly means ranging from 3.94 to 4.25, exhibit a spatial pattern consistent with annualized averages (Appendix A3). However, in August, the mean VOC:NO_x ratio across the study domain increases to 7.15, indicative of a potential shift toward a transitional state between VOC- and NO_x-limited regimes in some areas of the Greater Chicago region.

When all MHDV tailpipe emissions are removed, the Greater Chicago region domain annual mean VOC:NO_x ratios increase to 6.28 and localized ratios reach 10.64 in the collar counties (Fig. 5(b)). However, despite the increase in VOC:NO_x ratios across the study domain, parts of the city of Chicago – particularly along primary roadways – are still VOC-limited (VOC:NO_x < 4). When simulating the ACT policy adoption scenario, the annual mean VOC:NO_x ratio for the Greater Chicago region is higher than the baseline domain mean but lower than the ratios when all MHDV emissions are removed (5.21), with isolated areas reaching 9.28 (Fig. 5(c)). In August, mean VOC:NO_x ratios increase to 7.98 within the study domain, indicating a transitional regime that may contribute to the observed smaller extent of MDA8 O_3 increases during the summer month. This finding underscores the potential of zero-emission MHDV

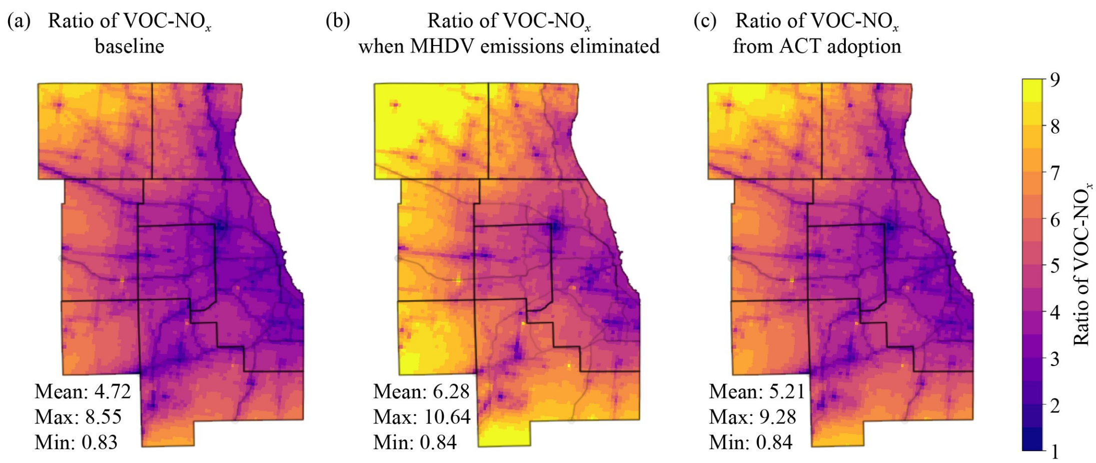

Fig. 5 WRF-CMAQ simulated annualized mean (August and October 2018, January and April 2019) volatile organic compounds (VOC) to NO_x ratios for (a) baseline, (b) 100% zero-emission MHDV scenario and, (c) an Illinois Advance Clean Trucks policy scenario over the Greater Chicago region (Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will Counties).

adoption strategies to facilitate O_3 reductions, as evidenced by the increase in annualized average VOC:NO_x ratios in both sensitivity simulations. However, it also highlights that isolated MHDV-specific policy interventions are insufficient to shift the O_3 regime to be NO_x-limited within the entire Greater Chicago region. Therefore, additional measures, such as VOC emission controls or additional vehicle sector emission reductions are necessary to achieve a full transition to a NO_x-limited regime within the Greater Chicago region.

3.3 Zero-emission MHDV adoption policy on health and equity outcomes

Next, we examine the health and equity implications of MHDV-related pollution across the Greater Chicago region at the census-tract scale. This assessment involves evaluating the change in simulated criteria air pollutants alongside USALEEP all-cause mortality rates for each census tract across the domain. Here, we find MHDVs contribute to ~1330 (95% confidence interval (CI: 330, 2000) premature deaths per year and 1580 (CI: 310, 3870) new cases of pediatric asthma due to NO_2 exposure within the region. Due to MHDVs contributions to reduced MDA8 O_3 concentrations, we estimate that 110 (CI: 50, 210) premature deaths per year are avoided by MHDV emissions within the study domain.

Within the study domain, we integrate our findings of simulated air pollution and health outcomes with census tract demographic composition to evaluate the equity impacts of MHDV emissions. The demographic composition of the Greater Chicago region includes residents that are 51% white, 17% Black, 23% Hispanic or Latino, and 7% Asian (Appendix A4). When examining the total impacts of MHDVs within the Greater Chicago region, people of color bear a disproportionate burden, as census tracts with the highest MHDV pollution exposure (i.e., 10th decile) consist of 45% Black, 33% white, 13% Hispanic or Latino, and 7% Asian populations. Within these census tracts, MHDV-related pollution contributes up to 4.16 ppb of NO_2. Census tracts with the largest MHDV-related NO_2 health impacts experience premature death rates of up to 49 deaths annually per 100000 residents. In contrast, census tracts with the lowest MHDV exposure, predominantly composed of white residents, exhibit marginal rates of NO_2-related health impacts, with fewer than 1 premature death annually per 100000 residents from MHDV-related pollutants.

In estimating the health benefits of an ACT policy implementation scenario for Illinois, our analysis indicates that the Greater Chicago region would experience a reduction of 500 premature deaths per year (CI: −120, −750), primarily attributed to decreases in NO_2, representing a reduction of 37.6% in MHDV-related NO_2 mortality (Table 2). All census tracts within the area experience decreases in attributable mortality rates, with rates of up to 71 deaths per year per 100000 people avoided in census tracts with the largest reductions in NO_2 exposure (Appendix A2). Additionally, reductions in NO_2 would lead to a decrease in pediatric asthma cases across the Greater Chicago region, amounting to 600 (CI: 120, −1440) new cases prevented annually, representing a 38.0% reduction in new pediatric cases attributable to MHDV-related pollution. The increase in MDA8 O_3 would result in an increase of 40 (CI: 22, 90) deaths per year, with individual census tracts seeing up to 7 additional deaths per 100000 people each year.

Under an ACT policy adoption scenario, the most substantial NO_2 reductions, i.e., reductions larger than 1.5 ppb, are primarily observed in census tracts composed of a higher percentage of residents of color (Fig. 6(a)). When considering the 10th decile, which identifies communities simulated to have the largest reductions in MHDV-related pollution exposure, non-white residents collectively make up over 50% of the decile. However, when examining variations in MDA8 O_3, minimal change in concentrations occurs within regions predominantly inhabited by white residents, whereas the most substantial disbenefits are observed in areas with demographic compositions exceeding 60% nonwhite in the 10th decile (Fig. 5(b)). Census tracts that experience the largest reductions in NO_2 (top decile) are estimated to have reductions in NO_2-attributable mortality of up to 18 premature deaths per year per 100000 people annually, with nonwhite residents experiencing the largest benefits (Fig. 5(c)). For example, the residents of census tracts with the largest NO_2-associated reductions in mortality are 48% Black, 12% Hispanic or Latino, 7% Asian and 31% white. Larger health benefits for Black residents are,

Table 2 Attributable annual premature deaths (per 100,000 for 30 years and older) from exposure to NO_2 and MDA8 O_3 concentrations and new cases of pediatric asthma due to NO_2 exposure from (first row) MHDV-attributable pollutant concentrations, (second row) reductions in MHDV pollution concentrations as a result of an Illinois ACT policy adoption scenario, (third row) percent change in MHDV health impacts from ACT policy adoption scenario compared to baseline over the Greater Chicago region (Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will Counties)

Items	Attributable mortality NO_2	Attributable mortality MDA8 O_3	Pediatric asthma (New Cases)
MHDVs total contribution	1330 (CI: 330, 2000)	−110 (CI: −50, −210)	1580 (CI: 3870, 310)
ACT policy reductions	−500 (CI: −120, −750)	+40 (CI: 22, 90)	−600 (CI: 120, −1440)
Percent reduction	−37.6%	+36.3%	−38.0%

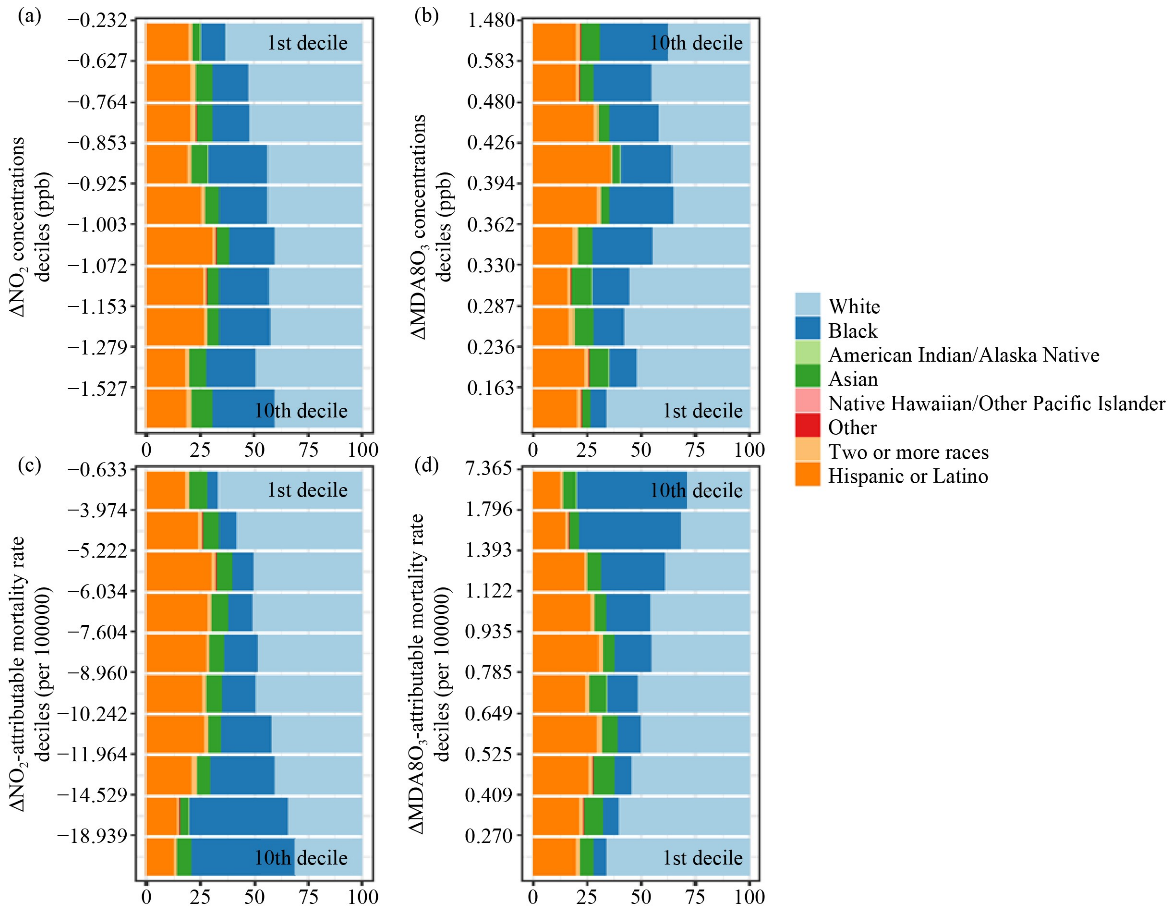

Fig. 6 Deciles of (a, b) change in NO_2 and MDA8 O_3 concentrations between an ACT policy scenario and baseline and (c, d) change in NO_2 and MDA8 O_3 attributable mortality rates stratified by race and ethnic composition over the Greater Chicago region.

in part, attributed to higher baseline mortality rates among this demographic group (Camilleri et al., 2023b).

4 Discussion

Utilizing a high-resolution regulatory-grade CTM, this study characterizes the air pollution, health, and equity disbenefits of current MHDV tailpipe emissions and evaluates the efficacy of an ACT policy to ameliorate these negative outcomes in the Greater Chicago region. Our findings highlight the substantial impact MHDV emissions have on local air pollution and public health, particularly for neighborhoods with a higher percentage of nonwhite residents. Given this context, we find that the implementation of an ACT policy in Illinois offers promise for mitigating some of the adverse effects of MHDV pollution, with the largest localized reductions of MHDV-related NO_2 pollution simulated in census tracts composed of a higher percentage of residents of color. The health and equity benefits of reduced MHDV-related NO_2 pollution are slightly offset by associated marginal increases in MDA8 O_3 concentrations that disproportionately impact non-white residents, with the highest increased O_3 concentrations observed along primary roadways. However, even in the areas where O_3 would be increased, health benefits from reduced NO_2 outweigh the disbenefits associated with increased O_3 exposure.

We find that our instantaneous ACT policy adoption scenario would reduce localized NO_2 concentrations up to 42% within our study domain, with overall population-weighted mean NO_2 decreasing ~8%. This decrease is notable given epidemiological advances that have strengthened the evidence linking NO_2 exposure to premature mortality. In 2020 Huangfu and Atkinson indicated “moderate confidence” in the linkage of NO_2 exposure with premature mortality. In 2021 the World Health Organization cited new epidemiological evidence in revising its NO_2 air quality guidelines to be more stringent (10 μg/m^3 ≈ 5.3 ppb annual average) (World Health Organization, 2021). Most recently, a systematic review and meta-analysis conducted by the Health Effects Institute (HEI) in 2022 found “high confidence” in NO_2 attributable mortality. Using relative risk derived from the 2022 HEI systematic review and meta-analysis, NO_2-attributable mortality in the U.S. was estimated at nearly 171,000 premature deaths annually, with the Chicago region experiencing mortality rates 1.3 times higher than the CONUS average (Camilleri et al., 2023a). NO_2 has also been found to exacerbate asthma in children due to its potential to cause airway inflammation and oxidative stress (Achakulwisut et al., 2019). These findings detail the growing epidemiological confidence in the health harmful effects of NO_2 exposure sit in contrast with the U.S. annual primary and secondary NO_2 standards (53 ppb), which have not changed since 1971, and the 1-h standard of 100 ppb, which was last updated in 2010 (U.S. Environmental Protection Agency, 2018). In addition, NO_x emissions are a public health concern due to their role as precursors to tropospheric O_3 and fine particulate matter, both of which are contributors to air pollution-related morbidities and mortality. Given the context of these studies and the large contribution of NO_x emissions from the transportation sector in the U.S., our results underscore the importance of targeted policies, such as the ACT, to reduce NO_2 concentrations.

Our results suggest that the adoption of an ACT policy would lead to a reduction in NO_2 concentrations but would concurrently result in marginally increased MDA8 O_3 concentrations across most of the Greater Chicago region. This observation is consistent with previous studies that simulate zero-emission vehicle adoption, indicating that when traffic-related NO_x pollution decreases, there is the possibility of a subsequent increase in MDA8 O_3 concentrations due to the role NO plays in suppressing the formation and survival of O_3 in VOC-limited environments. For example, Visa et al. (2023) simulated the electrification of 30% of all transportation modes (motorcycles, primarily gasoline-fueled passenger light-duty cars and trucks, and primarily heavy-duty diesel-fueled refuse trucks, motorhomes, commercial short- and long-haul trucks, and intercity, transit, and school buses) in the Chicago region and found increases in MDA8 O_3 exceedance days in urban regions. Even studies that simulate a full conversion of on-road vehicles to zero-emission fleets, as well as consider changes in future fleet composition and traffic volumes, find an increase in simulated MDA8 O_3 concentrations of up to 1.09 ppb (Mousavinezhad et al., 2024). This highlights the potential necessity of considering supplementary policy measures at the city level to limit VOC emissions (Wang et al., 2024), in addition to efforts aimed at reducing traffic-related pollution.

Our ACT scenario results suggest that the implementation of an ACT policy has the potential to not only enhance air quality but also yield ancillary benefits by reducing adverse health outcomes and mitigating socioeconomic impacts. We find that an ACT policy adoption in the Greater Chicago region would reduce MHDV-related NO_2 adverse health outcomes by ~38%. Indeed, despite the potential increase in O_3 concentrations in urban areas (e.g., Cook County, along primary roadways), the health benefits stemming from reductions in NO_2 outweigh the adverse effects associated with additional O_3. Moreover, we utilize the 2017 estimated value of a statistical life, which is 9.6 million U.S. dollar (Viscusi and Masterman, 2017), to estimate that a decrease in MHDV-related NO_2 mortality would result in an annual decrease of 4.8 billion U.S. dollar in health damages within the Greater Chicago region. An ACT policy would also lead to an annual decrease of 3.9 million tons of CO_2 emissions in the Greater Chicago region. Using a social cost of carbon, set at 185 US dollar per metric ton of CO_2 to account for the socioeconomic impacts of greenhouse gas emissions (Rennert et al., 2022), this reduction would result in an annual benefit of 731 million U.S. dollar. This finding highlights that economic benefits derived from improved air quality can outweigh the economic benefits from reductions in greenhouse gas emissions, consistent with previous literature (Shindell et al., 2021).

Our study examines the racial and ethnic composition of air pollutant exposure and associated health outcomes, and suggests that neighborhoods with higher percentages of residents of color stand to experience the greatest health benefits from an ACT policy adoption. Previous literature has identified persistent equity gaps associated with zero-emission passenger vehicle adoption, noting that the benefits are more likely to be realized by non-disadvantaged communities (Yu et al., 2023). This is attributed to the ability of residents in these areas to afford zero-emission vehicles, coupled with the greater likelihood of charging stations located within more affluent neighborhoods (Hsu and Fingerman, 2021). Our MHDV-focused results suggest a different equity outcome. We find that implementing policies aimed at transitioning MHDVs to zero-emission vehicles in the Greater Chicago region presents a more equitable approach since a majority of non-white and low-income populations reside near major roadways where MHDVs are prevalent. Our findings underscore the potential advantages of targeted zero-emission vehicle adoption policies. However, it is necessary to acknowledge that our study does not address the equity outcomes associated with all aspects of zero-emission vehicles. A comprehensive cradle-to-grave life cycle assessment of zero-emission MHDVs is needed to provide additional insights into the full spectrum of benefits and tradeoffs associated with zero-emission vehicle transition policies (Das et al., 2023). Furthermore, our analysis only considers the Greater Chicago region, but research has demonstrated that zero-emission vehicle adoption benefits and trade-offs vary by region (He et al., 2016; Pan et al., 2019; Peters et al., 2020; Schnell et al., 2021; Skipper et al., 2023; Mousavinezhad et al., 2024). However, given the substantial impact of transportation-related pollutants and the increasing relative ethnic and racial disparities in pollution-attributable health burdens observed in recent years, policy interventions explicitly aimed at reducing inequalities in pollution exposure are needed. Our simulation of an ACT policy scenario demonstrates how targeting MHDVs for transition to zero-emission vehicles contributes to lessening the inequitable health burden experienced by predominantly non-white communities.

A prior study that examined the implications of an instantaneous transition to 30% electric heavy-duty vehicles focused on the same region reported population-weighted reductions of 0.5 ppb of NO_2 (~6%) and an increase in MDA8 O_3 of up to ~1.5 ppb in the urban core of Chicago (Camilleri et al., 2023b). In comparison, our analysis of an ACT policy scenario simulates a similar magnitude increase in MDA8 O_3 but a larger magnitude decrease in population-weighted NO_2 concentrations (−0.98 ppb, or ~8%). Given that our ACT policy simulation transitions ~48% of MHDVs to zero-emission vehicles, compared to the 30% transition of only HDVs in Camilleri et al., we would anticipate more substantial NO_2 reductions in the ACT simulation. However, additional differences between these two studies likely arise due to different emission modeling platforms (i.e., SMOKE 2016V2 platform and 2016Beta platform), as the 2016Beta platform has higher emission rates for heavy-duty diesel vehicles (US Environmental Protection Agency, 2021b; Lang et al., 2025). Although the findings are closely aligned, discrepancies underscore the importance of considering specific emission modeling platforms when evaluating the air quality impacts of transitioning to zero-emission vehicles.

While our analysis showcases the value of both community-engaged and policy-relevant science, substantial work remains. The EPA's finalization of the Clean Truck Plan in 2022, which targets substantial reductions in NO_x emissions from heavy-duty vehicles starting with model year 2027 (US Environmental Protection Agency, 2021a), highlights the importance of incorporating the most up-to-date policies into future zero-emission vehicle assessment frameworks. We also note that our study is based on current vehicle fleet characteristics and future changes in fleet makeup may further contribute to reductions in traffic-related pollution. Therefore, future analyses should account for projected fleet traffic volumes and changes in fleet composition. Moreover, research has identified heightened and disproportionate pollution impacts near inter-regional freight facilities (Thind et al., 2023; Goldberg et al., 2024; Kerr et al., 2024a), emphasizing the need to explore policy-based solutions tailored to address the localized effects of medium- and heavy-duty vehicle activity.

5 Conclusions

This study demonstrates that neighborhood-scale CTMs can be leveraged to evaluate the impacts of policy interventions on racial and ethnic disparities in traffic-related air pollution, with community feedback playing a pivotal role in enhancing the scope and application of the research. As local community groups advocate for the urgent need to tackle issues of environmental injustice, our findings offer insights into the potential of policy measures, such as an ACT policy, to improve air quality and reduce health inequities, particularly in marginalized communities. Future research and policy development are essential to attain equitable outcomes across all populations, necessitating interdisciplinary collaboration and community participation to shape effective and equitable strategies aimed at mitigating environmental burdens from the transportation sector.

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Competing interests The authors declare that they have no competing interests.

References

Achakulwisut P, Brauer M, Hystad P, Anenberg S C (2019). Global, national, and urban burdens of paediatric asthma incidence attributable to ambient NO_2 pollution: estimates from global datasets. Lancet Planet Health, 3(4): e166–e178

Anenberg S C, Miller J, Henze D K, Minjares R, Achakulwisut P (2019). The global burden of transportation tailpipe emissions on air pollution-related mortality in 2010 and 2015. Environ Res Lett, 14(9): 094012

Anenberg S C, Mohegh A, Goldberg D L, Kerr G H, Brauer M, Burkart K, Hystad P, Larkin A, Wozniak S, Lamsal L (2022). Long-term trends in urban NO_2 concentrations and associated paediatric asthma incidence: estimates from global datasets. Lancet Planet Health, 6(1): e49–e58

Antonczak B, Thompson T M, DePaola M W, Rowangould G (2023). 2020 Near-roadway population census, traffic exposure and equity in the United States. Transp Res Part D Transp Environ, 125: 103965

Apte J S, Messier K P, Gani S, Brauer M, Kirchstetter T W, Lunden M M, Marshall J D, Portier C J, Vermeulen R C H, Hamburg S P (2017). High-resolution air pollution mapping with Google street view cars: exploiting big data. Environ Sci Technol, 51(12): 6999–7008

Ashok A, Barrett S R H (2016). Adjoint-based computation of U. S. nationwide ozone exposure isopleths. Atmos Environ, 133: 68–80

Bickford E, Holloway T, Karambelas A, Johnston M, Adams T, Janssen M, Moberg C (2014). Emissions and air quality impacts of truck-to-rail freight modal shifts in the midwestern United States. Environ Sci Technol, 48(1): 446–454

Byun D, Schere K L (2006). Review of the governing equations, computational algorithms, and other components of the Models-3 Community Multiscale Air Quality (CMAQ) modeling system. Appl Mech Rev, 59(2): 51–77

Camilleri S F, Montgomery A, Visa M A, Schnell J L, Adelman Z E, Janssen M, Grubert E A, Anenberg S C, Horton D E (2023b). Air quality, health and equity implications of electrifying heavy-duty vehicles. Nat Sustain, 6(12): 1643–1653

Camilleri S F, Kerr G H, Anenberg S C, Horton D E (2023a). All-cause NO2 -attributable mortality burden and associated racial and ethnic disparities in the United States. Environ Sci Technol Lett, acs.estlett.3c00500

CARB (2021). CARB passes "smog check" regulation for heavy duty trucks and buses. Available at California Air Resources Board website

Center for Neighborhood Technology (2024). Chicago Truck Data Portal. Available at Track Count Data website

Chambliss S E, Pinon C P R, Messier K P, LaFranchi B, Upperman C R, Lunden M M, Robinson A L, Marshall J D, Apte J S (2021). Local- and regional-scale racial and ethnic disparities in air pollution determined by long-term mobile monitoring. Proc Natl Acad Sci USA, 118(37): e2109249118

Cidell J (2010). Concentration and decentralization: the new geography of freight distribution in US metropolitan areas. J Transp Geogr, 18(3): 363–371

Clark L P, Harris M H, Apte J S, Marshall J D (2022). National and intraurban air pollution exposure disparity estimates in the United States: impact of data-aggregation spatial scale. Environ Sci Technol Lett, 9(9): 786–791

Climate and Equitable Jobs Act (2021). Available at Illinois Government website

CMAP (2017). Chicago Metropolitan Agency for Planning: Data: The Freight System. Available at Illinois Government website

Das P K, Bhat M Y, Sajith S (2023). Life cycle assessment of electric vehicles: a systematic review of literature. Environ Sci Pollut Res Int, 31(1): 73–89

Davidson K, Fann N, Zawacki M, Fulcher C, Baker K R (2020). The recent and future health burden of the U. S. mobile sector apportioned by source. Environ Res Lett, 15(7): 075009

Demetillo M A G, Harkins C, McDonald B C, Chodrow P S, Sun K, Pusede S E (2021). Space‐based observational constraints on NO_2 air pollution inequality from diesel traffic in major US cities. Geophysical Research Letters, 48: e2021GL094333

Dennis R, Fox T, Fuentes M, Gilliland A, Hanna S, Hogrefe C, Irwin J, Rao S T, Scheffe R, Schere K, Steyn D, Venkatram A (2010). A framework for evaluating regional-scale numerical photochemical modeling systems. Environ Fluid Mech, 10(4): 471–489

deSouza P N, Anenberg S, Fann N, McKenzie L M, Chan E, Roy A, Jimenez J L, Raich W, Roman H, Kinney P L (2024). Evaluating the sensitivity of mortality attributable to pollution to modeling Choices: a case study for Colorado. Environ Int, 185: 108416

Environmental Defense Fund (2021). Medium- & Heavy-Duty Vehicles: Market structure, Environmental Impact, and EV Readin. Available at Environmental Defense Fund website

Environmental Defense Fund (2024). Illinois Warehouse Boom: Tracing the growth of mega-warehouses and their health impacts. Available at WTTW website

Eyth A, Vukovich J, Farkas C, Godfrey J (2022). Technical Support Document (TSD): Preparation of Emissions Inventories for the 2016v2 North American Emissions Modeling Platform. US Environmental Protection Agency, Office of Air Quality Planning and Standards

Gai Y, Minet L, Posen I D, Smargiassi A, Tétreault L F, Hatzopoulou M (2020). Health and climate benefits of electric vehicle deployment in the Greater Toronto and Hamilton Area. Environ Pollut, 265: 114983

Goldberg D L, Tao M, Kerr G H, Ma S, Tong D Q, Fiore A M, Dickens A F, Adelman Z E, Anenberg S C (2024). Evaluating the spatial patterns of U. S. urban NO_x emissions using TROPOMI NO_2. Remote Sens Environ, 300: 113917

He H, Liang X Z, Lei H, Wuebbles D J (2016). Future U. S. ozone projections dependence on regional emissions, climate change, long-range transport and differences in modeling design. Atmos Environ, 128: 124–133

HEI (2022). Systematic Review and Meta-analysis of Selected Health Effects of Long-Term Exposure to Traffic-Related Air Pollution. Special Report 23

Hsu C W, Fingerman K (2021). Public electric vehicle charger access disparities across race and income in California. Transp Policy, 100: 59–67

Huangfu P, Atkinson R (2020). Long-term exposure to NO_2 and O_3 and all-cause and respiratory mortality: a systematic review and meta-analysis. Environ Int, 144: 105998

Isaksen I S A, Granier C, Myhre G, Berntsen T K, Dalsøren S B, Gauss M, Klimont Z, Benestad R, Bousquet P, Collins W, Cox T, Eyring V, Fowler D, Fuzzi S, Jöckel P, Laj P, Lohmann U, Maione M, Monks P, Prevot A S H, Raes F, Richter A, Rognerud B, Schulz M, Shindell D, Stevenson D S, Storelvmo T, Wang W C, van Weele M, Wild M, Wuebbles D (2009). Atmospheric composition change: climate–chemistry interactions. Atmos Environ, 43(33): 5138–5192

Jordahl K, den Bossche J V, Fleischmann M, McBride J, Wasserman J, Gerard J, Badaracco A G, Snow A D, Tratner J, Perry M, Farmer C, Hjelle G A, Cochran M, Gillies S, Culbertson L, Bartos M, Caria G, Eubank N, Sangarshanan, Rey S, Maxalbert, Bilogur A, Ward B, Ren C, Arribas-Bel D, Flavin, Wasser L, Wolf L J, Journois M, Abonte (2021). geopandas/geopandas: v0.9.0.

Kerr G H, Goldberg D L, Anenberg S C (2021). COVID-19 pandemic reveals persistent disparities in nitrogen dioxide pollution. Proc Natl Acad Sci USA, 118(30): e2022409118

Kerr G H, Goldberg D L, Harris M H, Henderson B H, Hystad P, Roy A, Anenberg S C (2023). Ethnoracial disparities in nitrogen dioxide pollution in the United States: comparing data sets from satellites, models, and monitors. Environ Sci Technol, 57: 19532–19544

Kerr G H, Meyer M, Goldberg D L, Miller J, Anenberg S C (2024a). Air pollution impacts from warehousing in the United States uncovered with satellite data. Nat Commun, 15(1): 6006

Kerr G H, Van Donkelaar A, Martin R V, Brauer M, Bukart K, Wozniak S, Goldberg D L, Anenberg S C (2024b). Increasing racial and ethnic disparities in ambient air pollution-attributable morbidity and mortality in the United States. Environ Health Perspect, 132(3): 037002

Khreis H, Kelly C, Tate J, Parslow R, Lucas K, Nieuwenhuijsen M (2017). Exposure to traffic-related air pollution and risk of development of childhood asthma: a systematic review and meta-analysis. Environ Int, 100: 1–31

Koolik L H, Alvarado Á, Budahn A, Plummer L, Marshall J D, Apte J S (2024). PM2.5 exposure disparities persist despite strict vehicle emissions controls in California. Science Advances, 10(37): eadn8544

LADCO (2022). Attainment Demonstration Modeling for the 2015 Ozone National Ambient Air Quality Standard Technical Support Document. Available at Lake Michigan Air Directors Consortium website

Lane H M, Morello-Frosch R, Marshall J D, Apte J S (2022). Historical redlining is associated with present-day air pollution disparities in U. S. Cities. Environ Sci Technol Lett, 9(4): 345–350

Lang V A, Camilleri S F, Thompson T M, Harris M H, Harkins C, Tong D Q, Janssen M, Adelman Z E, Horton D E (2025). Intercomparison of modeled urban-scale vehicle NOx and PM2.5 emissions−implications for equity assessments. Environmental Science & Technology

Levy I, Mihele C, Lu G, Narayan J, Hilker N, Brook J R (2014). Elucidating multipollutant exposure across a complex metropolitan area by systematic deployment of a mobile laboratory. Atmos Chem Phys, 14(14): 7173–7193

Li N, Chen J, Tsai I, He Q, Chi S, Lin Y, Fu T (2016). Potential impacts of electric vehicles on air quality in Taiwan. Science of The Total Environment, 566-567: 919-928

Liang X, Zhang S, Wu Y, Xing J, He X, Zhang K M, Wang S, Hao J (2019). Air quality and health benefits from fleet electrification in China. Nat Sustain, 2(10): 962–971

Lippert J (2024). Neighborhoods near congested I-55 freight corridors count truck traffic, push for changes. Available at Chicagotribune. Com website

Manson S, Schroeder J, Van Riper D, Kugler T, Ruggles S (2023). IPUMS National Historical Geographic Information System: Version 17.0 [5-Year Data [2015–2019, Block Groups & Larger Areas]]

Mohegh A, Goldberg D, Achakulwisut P, Anenberg S C (2021). Sensitivity of estimated NO_2 -attributable pediatric asthma incidence to grid resolution and urbanicity. Environ Res Lett, 16(1): 014019

Montgomery A, Daepp M I G, Abdin M I, Choudhury P, Malvar S, Counts S, Horton D E (2023a). Intraurban NO_2 hotspot detection across multiple air quality products. Environ Res Lett, 18(10): 104010

Montgomery A, Schnell J L, Adelman Z, Janssen M, Horton D E (2023b). Simulation of neighborhood‐scale air quality with two‐way coupled WRF‐CMAQ over Southern Lake Michigan‐Chicago Region. JGR Atmospheres, 128: e2022JD037942

Mousavinezhad S, Choi Y, Khorshidian N, Ghahremanloo M, Momeni M (2024). Air quality and health co-benefits of vehicle electrification and emission controls in the most populated United States urban hubs: insights from New York, Los Angeles, Chicago, and Houston. Sci Total Environ, 912: 169577

Murray C J L, Aravkin A Y, Zheng P, Abbafati C, Abbas K M, Abbasi-Kangevari M, Abd-Allah F, Abdelalim A, Abdollahi M, Abdollahpour I, Abegaz K H, Abolhassani H, Aboyans V, Abreu L G, Abrigo M R M, Abualhasan A, Abu-Raddad L J, Abushouk A I, Adabi M, Adekanmbi V, Adeoye A M, Adetokunboh O O, Adham D, Advani S M, Agarwal G, Aghamir S M K, Agrawal A, Ahmad T, Ahmadi K, Ahmadi M, Ahmadieh H, Ahmed M B, Akalu T Y, Akinyemi R O, Akinyemiju T, Akombi B, Akunna C J, Alahdab F, Al-Aly Z, Alam K, Alam S, Alam T, Alanezi F M, Alanzi T M, Alemu B, Alhabib K F, Ali M, Ali S, Alicandro G, Alinia C, Alipour V, Alizade H, Aljunid S M, Alla F, Allebeck P, Almasi-Hashiani A, Al-Mekhlafi H M, Alonso J, Altirkawi K A, Amini-Rarani M, Amiri F, Amugsi D A, Ancuceanu R, Anderlini D, Anderson J A, Andrei C L, Andrei T, Angus C, Anjomshoa M, Ansari F, Ansari-Moghaddam A, Antonazzo I C, Antonio C A T, Antony C M, Antriyandarti E, Anvari D, Anwer R, Appiah S C Y, Arabloo J, Arab-Zozani M, Ariani F, Armoon B, Ärnlöv J, Arzani A, Asadi-Aliabadi M, Asadi-Pooya A A, Ashbaugh C, Assmus M, Atafar Z, Atnafu D D, Atout M M W, Ausloos F, Ausloos M, Ayala Quintanilla B P, Ayano G, Ayanore M A, Azari S, Azarian G, Azene Z N, Badawi A, Badiye A D, Bahrami M A, Bakhshaei M H, Bakhtiari A, Bakkannavar S M, Baldasseroni A, Ball K, Ballew S H, Balzi D, Banach M, Banerjee S K, Bante A B, Baraki A G, Barker-Collo S L, Bärnighausen T W, Barrero L H, Barthelemy C M, Barua L, Basu S, Baune B T, Bayati M, Becker J S, Bedi N, Beghi E, Béjot Y, Bell M L, Bennitt F B, Bensenor I M, Berhe K, Berman A E, Bhagavathula A S, Bhageerathy R, Bhala N, Bhandari D, Bhattacharyya K, Bhutta Z A, Bijani A, Bikbov B, Bin Sayeed M S, Biondi A, Birihane B M, Bisignano C, Biswas R K, Bitew H, Bohlouli S, Bohluli M, Boon-Dooley A S, Borges G, Borzì A M, Borzouei S, Bosetti C, Boufous S, Braithwaite D, Breitborde N J K, Breitner S, Brenner H, Briant P S, Briko A N, Briko N I, Britton G B, Bryazka D, Bumgarner B R, Burkart K, Burnett R T, Burugina Nagaraja S, Butt Z A, Caetano dos Santos F L, Cahill L E, Cámera L L A A, Campos-Nonato I R, Cárdenas R, Carreras G, Carrero J J, Carvalho F, Castaldelli-Maia J M, Castañeda-Orjuela C A, Castelpietra G, Castro F, Causey K, Cederroth C R, Cercy K M, Cerin E, Chandan J S, Chang K L, Charlson F J, Chattu V K, Chaturvedi S, Cherbuin N, Chimed-Ochir O, Cho D Y, Choi J Y J, Christensen H, Chu D T, Chung M T, Chung S C, Cicuttini F M, Ciobanu L G, Cirillo M, Classen T K D, Cohen A J, Compton K, Cooper O R, Costa V M, Cousin E, Cowden R G, Cross D H, Cruz J A, Dahlawi S M A, Damasceno A A M, Damiani G, Dandona L, Dandona R, Dangel W J, Danielsson A K, Dargan P I, Darwesh A M, Daryani A, Das J K, Das Gupta R, das Neves J, Dávila-Cervantes C A, Davitoiu D V, De Leo D, Degenhardt L, DeLang M, Dellavalle R P, Demeke F M, Demoz G T, Demsie D G, Denova-Gutiérrez E, Dervenis N, Dhungana G P, Dianatinasab M, Dias da Silva D, Diaz D, Dibaji Forooshani Z S, Djalalinia S, Do H T, Dokova K, Dorostkar F, Doshmangir L, Driscoll T R, Duncan B B, Duraes A R, Eagan A W, Edvardsson D, El Nahas N, El Sayed I, El Tantawi M, Elbarazi I, Elgendy I Y, El-Jaafary S I, Elyazar I R F, Emmons-Bell S, Erskine H E, Eskandarieh S, Esmaeilnejad S,

Esteghamati A, Estep K, Etemadi A, Etisso A E, Fanzo J, Farahmand M, Fareed M, Faridnia R, Farioli A, Faro A, Faruque M, Farzadfar F, Fattahi N, Fazlzadeh M, Feigin V L, Feldman R, Fereshtehnejad S M, Fernandes E, Ferrara G, Ferrari A J, Ferreira M L, Filip I, Fischer F, Fisher J L, Flor L S, Foigt N A, Folayan M O, Fomenkov A A, Force L M, Foroutan M, Franklin R C, Freitas M, Fu W, Fukumoto T, Furtado J M, Gad M M, Gakidou E, Gallus S, Garcia-Basteiro A L, Gardner W M, Geberemariyam B S, Gebreslassie A A A A, Geremew A, Gershberg Hayoon A, Gething P W, Ghadimi M, Ghadiri K, Ghaffarifar F, Ghafourifard M, Ghamari F, Ghashghaee A, Ghiasvand H, Ghith N, Gholamian A, Ghosh R, Gill P S, Ginindza T G G, Giussani G, Gnedovskaya E V, Goharinezhad S, Gopalani S V, Gorini G, Goudarzi H, Goulart A C, Greaves F, Grivna M, Grosso G, Gubari M I M, Gugnani H C, Guimarães R A, Guled R A, Guo G, Guo Y, Gupta R, Gupta T, Haddock B, Hafezi-Nejad N, Hafiz A, Haj-Mirzaian A, Haj-Mirzaian A, Hall B J, Halvaei I, Hamadeh R R, Hamidi S, Hammer M S, Hankey G J, Haririan H, Haro J M, Hasaballah A I, Hasan M M, Hasanpoor E, Hashi A, Hassanipour S, Hassankhani H, Havmoeller R J, Hay S I, Hayat K, Heidari G, Heidari-Soureshjani R, Henrikson H J, Herbert M E, Herteliu C, Heydarpour F, Hird T R, Hoek H W, Holla R, Hoogar P, Hosgood H D, Hossain N, Hosseini M, Hosseinzadeh M, Hostiuc M, Hostiuc S, Househ M, Hsairi M, Hsieh V C, Hu G, Hu K, Huda T M, Humayun A, Huynh C K, Hwang B F, Iannucci V C, Ibitoye S E, Ikeda N, Ikuta K S, Ilesanmi O S, Ilic I M, Ilic M D, Inbaraj L R, Ippolito H, Iqbal U, Irvani S S N, Irvine C M S, Islam M M, Islam S M S, Iso H, Ivers R Q, Iwu C C D, Iwu C J, Iyamu I O, Jaafari J, Jacobsen K H, Jafari H, Jafarinia M, Jahani M A, Jakovljevic M, Jalilian F, James S L, Janjani H, Javaheri T, Javidnia J, Jeemon P, Jenabi E, Jha R P, Jha V, Ji J S, Johansson L, John O, John-Akinola Y O, Johnson C O, Jonas J B, Joukar F, Jozwiak J J, Jürisson M, Kabir A, Kabir Z, Kalani H, Kalani R, Kalankesh L R, Kalhor R, Kanchan T, Kapoor N, Karami Matin B, Karch A, Karim M A, Kassa G M, Katikireddi S V, Kayode G A, Kazemi Karyani A, Keiyoro P N, Keller C, Kemmer L, Kendrick P J, Khalid N, Khammarnia M, Khan E A, Khan M, Khatab K, Khater M M, Khatib M N, Khayamzadeh M, Khazaei S, Kieling C, Kim Y J, Kimokoti R W, Kisa A, Kisa S, Kivimäki M, Knibbs L D, Knudsen A K S, Kocarnik J M, Kochhar S, Kopec J A, Korshunov V A, Koul P A, Koyanagi A, Kraemer M U G, Krishan K, Krohn K J, Kromhout H, Kuate Defo B, Kumar G A, Kumar V, Kurmi O P, Kusuma D, La Vecchia C, Lacey B, Lal D K, Lalloo R, Lallukka T, Lami F H, Landires I, Lang J J, Langan S M, Larsson A O, Lasrado S, Lauriola P, Lazarus J V, Lee P H, Lee S W H, LeGrand K E, Leigh J, Leonardi M, Lescinsky H, Leung J, Levi M, Li S, Lim L L, Linn S, Liu S, Liu S, Liu Y, Lo J, Lopez A D, Lopez J C F, Lopukhov P D, Lorkowski S, Lotufo P A, Lu A, Lugo A, Maddison E R, Mahasha P W, Mahdavi M M, Mahmoudi M, Majeed A, Maleki A, Maleki S, Malekzadeh R, Malta D C, Mamun A A, Manda A L, Manguerra H, Mansour-Ghanaei F, Mansouri B, Mansournia M A, Mantilla Herrera A M, Maravilla J C, Marks A, Martin R V, Martini S, Martins-Melo F R, Masaka A, Masoumi S Z, Mathur M R, Matsushita K, Maulik P K, McAlinden C, McGrath J J, McKee M, Mehndiratta M M, Mehri F, Mehta K M, Memish Z A, Mendoza W, Menezes R G, Mengesha E W, Mereke A, Mereta S T, Meretoja A, Meretoja T J, Mestrovic T, Miazgowski B, Miazgowski T, Michalek I M, Miller T R, Mills E J, Mini G K, Miri M, Mirica A, Mirrakhimov E M, Mirzaei H, Mirzaei M, Mirzaei R, Mirzaei-Alavijeh M, Misganaw A T, Mithra P, Moazen B, Mohammad D K, Mohammad Y, Mohammad Gholi Mezerji N, Mohammadian-Hafshejani A, Mohammadifard N, Mohammadpourhodki R, Mohammed A S, Mohammed H, Mohammed J A, Mohammed S, Mokdad A H, Molokhia M, Monasta L, Mooney M D, Moradi G, Moradi M, Moradi-Lakeh M, Moradzadeh R, Moraga P, Morawska L, Morgado-da-Costa J, Morrison S D, Mosapour A, Mosser J F, Mouodi S, Mousavi S M, Mousavi Khaneghah A, Mueller U O, Mukhopadhyay S, Mullany E C, Musa K I, Muthupandian S, Nabhan A F, Naderi M, Nagarajan A J, Nagel G, Naghavi M, Naghshtabrizi B, Naimzada M D, Najafi F, Nangia V, Nansseu J R, Naserbakht M, Nayak V C, Negoi I, Ngunjiri J W, Nguyen C T, Nguyen H L T, Nguyen M, Nigatu Y T, Nikbakhsh R, Nixon M R, Nnaji C A, Nomura S, Norrving B, Noubiap J J, Nowak C, Nunez-Samudio V, Oţoiu A, Oancea B, Odell C M, Ogbo F A, Oh I H, Okunga E W, Oladnabi M, Olagunju A T, Olusanya B O, Olusanya J O, Omer M O, Ong K L, Onwujekwe O E, Orpana H M, Ortiz A, Osarenotor O, Osei F B, Ostroff S M, Otstavnov N, Otstavnov S S, Øverland S, Owolabi M O, P A M, Padubidri J R, Palladino R, Panda-Jonas S, Pandey A, Parry C D H, Pasovic M, Pasupula D K, Patel S K, Pathak M, Patten S B, Patton G C, Pazoki Toroudi H, Peden A E, Pennini A, Pepito V C F, Peprah E K, Pereira D M, Pesudovs K, Pham H Q, Phillips M R, Piccinelli C, Pilz T M, Piradov M A, Pirsaheb M, Plass D, Polinder S, Polkinghorne K R, Pond C D, Postma M J, Pourjafar H, Pourmalek F, Poznańska A, Prada S I, Prakash V, Pribadi D R A, Pupillo E, Quazi Syed Z, Rabiee M, Rabiee N, Radfar A, Rafiee A, Raggi A, Rahman M A, Rajabpour-Sanati A, Rajati F, Rakovac I, Ram P, Ramezanzadeh K, Ranabhat C L, Rao P C, Rao S J, Rashedi V, Rathi P, Rawaf D L, Rawaf S, Rawal L, Rawassizadeh R, Rawat R, Razo C, Redford S B, Reiner R C Jr, Reitsma M B, Remuzzi G, Renjith V, Renzaho A M N, Resnikoff S, Rezaei N, Rezaei N, Rezapour A, Rhinehart P A, Riahi S M, Ribeiro D C, Ribeiro D, Rickard J, Rivera J A, Roberts N L S, Rodríguez-Ramírez S, Roever L, Ronfani L, Room R, Roshandel G, Roth G A, Rothenbacher D, Rubagotti E, Rwegerera G M, Sabour S, Sachdev P S, Saddik B, Sadeghi E, Sadeghi M, Saeedi R, Saeedi Moghaddam S, Safari Y, Safi S, Safiri S, Sagar R, Sahebkar A, Sajadi S M, Salam N, Salamati P, Salem H, Salem M R R, Salimzadeh H, Salman O M, Salomon J A, Samad Z, Samadi Kafil H, Sambala E Z, Samy A M, Sanabria J, Sánchez-Pimienta T G, Santomauro D F, Santos I S, Santos J V, Santric-Milicevic M M, Saraswathy S Y I, Sarmiento-Suárez R, Sarrafzadegan N, Sartorius B, Sarveazad A, Sathian B, Sathish T, Sattin D, Saxena S, Schaeffer L E, Schiavolin S, Schlaich M P, Schmidt M I, Schutte A E, Schwebel D C, Schwendicke F, Senbeta A M, Senthilkumaran S, Sepanlou S G, Serdar B, Serre M L, Shadid J, Shafaat O, Shahabi S, Shaheen A A, Shaikh M A, Shalash A S, Shams-Beyranvand M, Shamsizadeh M, Sharafi K, Sheikh A, Sheikhtaheri A, Shibuya K, Shield K D, Shigematsu M, Shin J I, Shin M J, Shiri R, Shirkoohi R, Shuval K, Siabani S, Sierpinski R, Sigfusdottir I D, Sigurvinsdottir R, Silva J P, Simpson K E, Singh J A, Singh P,

Skiadaresi E, Skou S T, Skryabin V Y, Smith E U R, Soheili A, Soltani S, Soofi M, Sorensen R J D, Soriano J B, Sorrie M B, Soshnikov S, Soyiri I N, Spencer C N, Spotin A, Sreeramareddy C T, Srinivasan V, Stanaway J D, Stein C, Stein D J, Steiner C, Stockfelt L, Stokes M A, Straif K, Stubbs J L, Sufiyan M B, Suleria H A R, Suliankatchi Abdulkader R, Sulo G, Sultan I, Szumowski Ł, Tabarés-Seisdedos R, Tabb K M, Tabuchi T, Taherkhani A, Tajdini M, Takahashi K, Takala J S, Tamiru A T, Taveira N, Tehrani-Banihashemi A, Temsah M H, Tesema G A, Tessema Z T, Thurston G D, Titova M V, Tohidinik H R, Tonelli M, Topor-Madry R, Topouzis F, Torre A E, Touvier M, Tovani-Palone M R R, Tran B X, Travillian R, Tsatsakis A, Tudor Car L, Tyrovolas S, Uddin R, Umeokonkwo C D, Unnikrishnan B, Upadhyay E, Vacante M, Valdez P R, van Donkelaar A, Vasankari T J, Vasseghian Y, Veisani Y, Venketasubramanian N, Violante F S, Vlassov V, Vollset S E, Vos T, Vukovic R, Waheed Y, Wallin M T, Wang Y, Wang Y P, Watson A, Wei J, Wei M Y W, Weintraub R G, Weiss J, Werdecker A, West J J, Westerman R, Whisnant J L, Whiteford H A, Wiens K E, Wolfe C D A, Wozniak S S, Wu A M, Wu J, Wulf Hanson S, Xu G, Xu R, Yadgir S, Yahyazadeh Jabbari S H, Yamagishi K, Yaminfirooz M, Yano Y, Yaya S, Yazdi-Feyzabadi V, Yeheyis T Y, Yilgwan C S, Yilma M T, Yip P, Yonemoto N, Younis M Z, Younker T P, Yousefi B, Yousefi Z, Yousefinezhadi T, Yousuf A Y, Yu C, Yusefzadeh H, Zahirian Moghadam T, Zamani M, Zamanian M, Zandian H, Zastrozhin M S, Zhang Y, Zhang Z J, Zhao J T, Zhao X J G, Zhao Y, Zhou M, Ziapour A, Zimsen S R M, Brauer M, Afshin A, Lim S S (2020). Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet, 396(10258): 1223–1249

Pan S, Roy A, Choi Y, Eslami E, Thomas S, Jiang X, Gao H O (2019). Potential impacts of electric vehicles on air quality and health endpoints in the Greater Houston Area in 2040. Atmos Environ, 207: 38–51

Peng L, Liu F, Zhou M, Li M, Zhang Q, Mauzerall D L (2021). Alternative-energy-vehicles deployment delivers climate, air quality, and health co-benefits when coupled with decarbonizing power generation in China. One Earth, 4(8): 1127–1140

Peters D R, Schnell J L, Kinney P L, Naik V, Horton D E (2020). Public health and climate benefits and trade-offs of U. S. vehicle electrification. GeoHealth, 4: e2020GH000275

Polonik P, Ricke K, Reese S, Burney J (2023). Air quality equity in US climate policy. Proc Natl Acad Sci USA, 120(26): e2217124120

Raich W, Fant C, Jackson M, Roman H (2020). Memorandum Supporting Near-Source Health Benefits Analyses Using Fine-Scale Incidence Rates. Industrial Economics, Inc.

Rennert K, Errickson F, Prest B C, Rennels L, Newell R G, Pizer W, Kingdon C, Wingenroth J, Cooke R, Parthum B, Smith D, Cromar K, Diaz D, Moore F C, Müller U K, Plevin R J, Raftery A E, Ševčíková H, Sheets H, Stock J H, Tan T, Watson M, Wong T E, Anthoff D (2022). Comprehensive evidence implies a higher social cost of CO_2. Nature, 610(7933): 687–692

Robo E, Seamonds D, Freeman M, Saha A, MacNair D (2022). Illinois Clean Trucks Program. Available at NRDC website

Schnell J L, Naik V, Horowitz L W, Paulot F, Ginoux P, Zhao M, Horton D E (2019). Air quality impacts from the electrification of light-duty passenger vehicles in the United States. Atmos Environ, 208: 95–102

Schnell J L, Peters D R, Wong D C, Lu X, Guo H, Zhang H, Kinney P L, Horton D E (2021). Potential for electric vehicle adoption to mitigate extreme air quality events in China. Earths Futur, 9(2): e2020EF001788

Seinfeld J H, Pandis S N (2016). Atmospheric Chemistry and Physics: From Air Pollution to Climate Change. New York: John Wiley & Sons

Shindell D, Ru M, Zhang Y, Seltzer K, Faluvegi G, Nazarenko L, Schmidt G A, Parsons L, Challapalli A, Yang L, Glick A (2021). Temporal and spatial distribution of health, labor, and crop benefits of climate change mitigation in the United States. Proc Natl Acad Sci USA, 118(46): e2104061118

Skamarock W C, Klemp J B, Dudhia J, Gill D O, Barker D M, Duda M G, Huang X Y, Wang W, Powers J G (2008). A Description of the Advanced Research WRF Version 3. doi: 10.5065/D68S4MVH

Skipper T N, Lawal A S, Hu Y, Russell A G (2023). Air quality impacts of electric vehicle adoption in California. Atmos Environ, 294: 119492

Southerland V A, Anenberg S C, Harris M, Apte J, Hystad P, Van Donkelaar A, Martin R V, Beyers M, Roy A (2021). Assessing the distribution of air pollution health risks within cities: a neighborhood-scale analysis leveraging high-resolution data sets in the bay area, California. Environ Health Perspect, 129(3): 037006

The White House (2023). Clean Energy Tax Provisions in the Inflation Reduction Act. Available at Whitehouse website

Thind M P S, Tessum C W, Marshall J D (2023). Environmental health, racial/ethnic health disparity, and climate impacts of inter-regional freight transport in the United States. Environ Sci Technol, 57(2): 884–895

Torbatian S, Saleh M, Xu J, Minet L, Gamage S M, Yazgi D, Yamanouchi S, Roorda M J, Hatzopoulou M (2024). Societal co-benefits of zero-emission vehicles in the freight industry. Environ Sci Technol, 58(18): 7814–7825

Turner M C, Jerrett M, Pope C A III, Krewski D, Gapstur S M, Diver W R, Beckerman B S, Marshall J D, Su J, Crouse D L, Burnett R T (2016). Long-term ozone exposure and mortality in a large prospective study. Am J Respir Crit Care Med, 193(10): 1134–1142

U.S. Environmental Protection Agency (2017). 2017 National Emissions Inventory (NEI) Data. Available at United States Environmental Protection Agency website

U.S. Environmental Protection Agency (2018). Review of the Primary National Ambient Air Quality Standards for Oxides of Nitrogen. Available at Federal Register website

U.S. Environmental Protection Agency (2021a). EPA Announces the "Clean Trucks Plan". Available at United States Environmental Protection Agency website

U.S. Environmental Protection Agency (2021b). Overview of EPA's MOtor Vehicle Emission Simulator (MOVES3). Available at United States Environmental Protection Agency website

Visa M A, Camilleri S F, Montgomery A, Schnell J L, Janssen M, Adelman Z E, Anenberg S C, Grubert E A, Horton D E (2023). Neighborhood-scale air quality, public health, and equity implications of multi-modal vehicle electrification. Environ Res: Infrastruct Sustain, 3(3): 035007

Viscusi W K, Masterman C J (2017). Income elasticities and global values of a statistical life. J Benefit Cost Anal, 8(2): 226–250 doi:10.1017/bca.2017.12.

Wang W, Li X, Cheng Y, Parrish D D, Ni R, Tan Z, Liu Y, Lu S, Wu Y, Chen S, Lu K, Hu M, Zeng L, Shao M, Huang C, Tian X, Leung K M, Chen L, Fan M, Zhang Q, Rohrer F, Wahner A, Pöschl U, Su H, Zhang Y (2024). Ozone pollution mitigation strategy informed by long-term trends of atmospheric oxidation capacity. Nat Geosci, 17(1): 20–25

Wang Y, Apte J S, Hill J D, Ivey C E, Johnson D, Min E, Morello-Frosch R, Patterson R, Robinson A L, Tessum C W, Marshall J D (2023). Air quality policy should quantify effects on disparities. Science, 381(6655): 272–274

Wolff G T, Kahlbaum D F, Heuss J M (2013). The vanishing ozone weekday/weekend effect. J Air Waste Manag Assoc, 63(3): 292–299

Wong D C, Pleim J, Mathur R, Binkowski F, Otte T, Gilliam R, Pouliot G, Xiu A, Young J O, Kang D (2012). WRF-CMAQ two-way coupled system with aerosol feedback: software development and preliminary results. Geosci Model Dev, 5(2): 299–312

World Health Organization (2021). WHO global air quality guidelines. Available at WHO IRIS website

WWJ (2023). For Good Jobs and Clean Air. Available at Warehouse Workers for Justice website

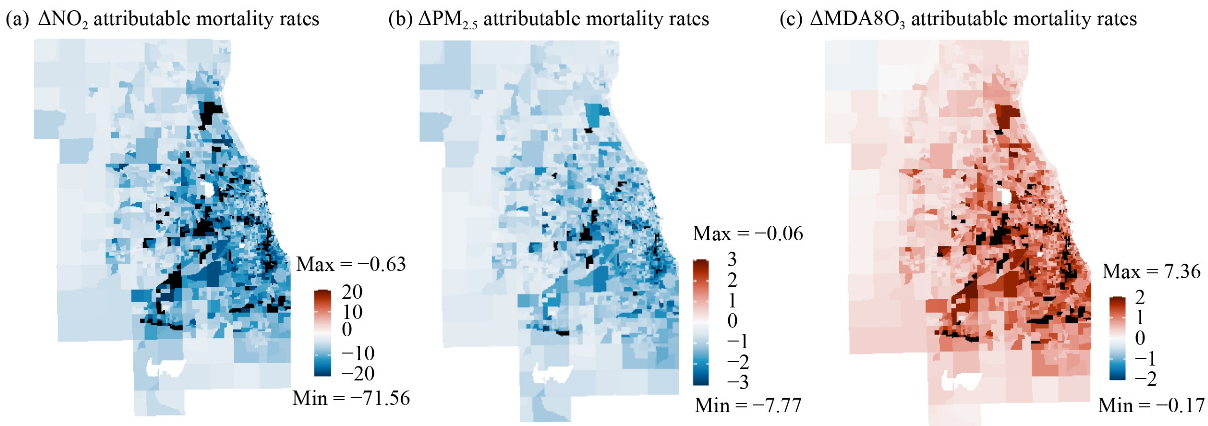
Yu Q, He B Y, Ma J, Zhu Y (2023). California's zero-emission vehicle adoption brings air quality benefits yet equity gaps persist. Nat Commun, 14(1): 7798

Zhang H, Chen G, Hu J, Chen S H, Wiedinmyer C, Kleeman M, Ying Q (2014). Evaluation of a seven-year air quality simulation using the Weather Research and Forecasting (WRF)/Community Multiscale Air Quality (CMAQ) models in the eastern United States. Sci Total Environ, 473–474: 275–285

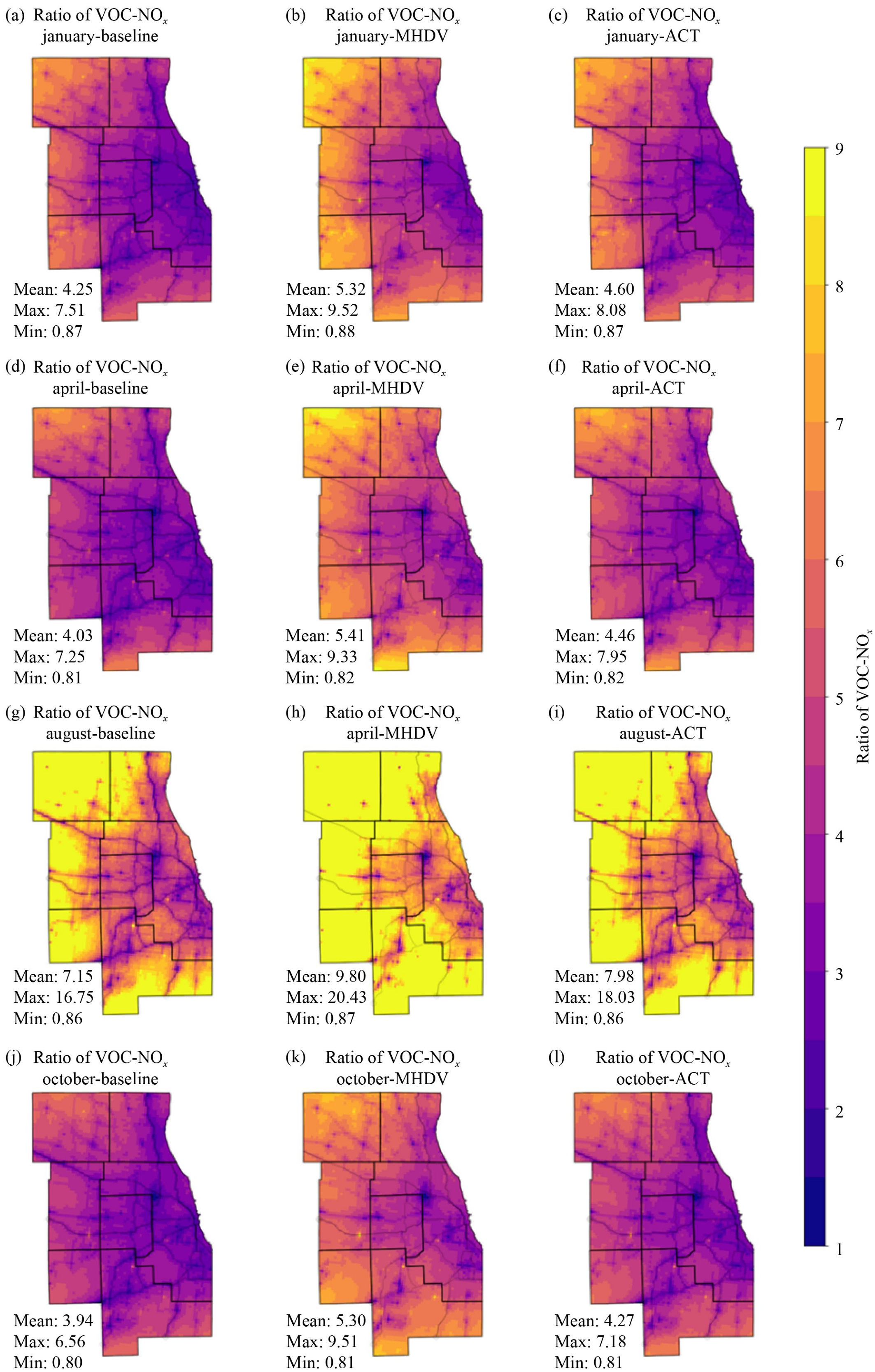
Appendices

	Month	μd	μp	*MB*	*RMSE*	*NMB*/%	*NME*/%	*r*
NO_2	08/2018	10.24	10.53	0.29	8.82	2.79	57.10	0.57
	10/2018	10.88	11.56	0.68	9.96	6.22	62.63	0.50
	01/2019	13.09	9.72	−3.37	8.15	−25.74	44.64	0.65
	04/2019	10.66	9.55	−1.11	8.55	−10.42	52.52	0.63
	Average	11.22	10.34	−0.88	8.87	−6.79	54.22	0.59
O_3	08/2018	30.28	40.07	9.77	14.80	32.25	39.44	0.68
	10/2018	20.36	32.23	11.87	14.74	58.30	62.80	0.59
	01/2019	24.61	31.59	6.98	10.21	28.36	34.29	0.65
	04/2019	36.00	47.56	11.57	14.98	32.13	35.84	0.60

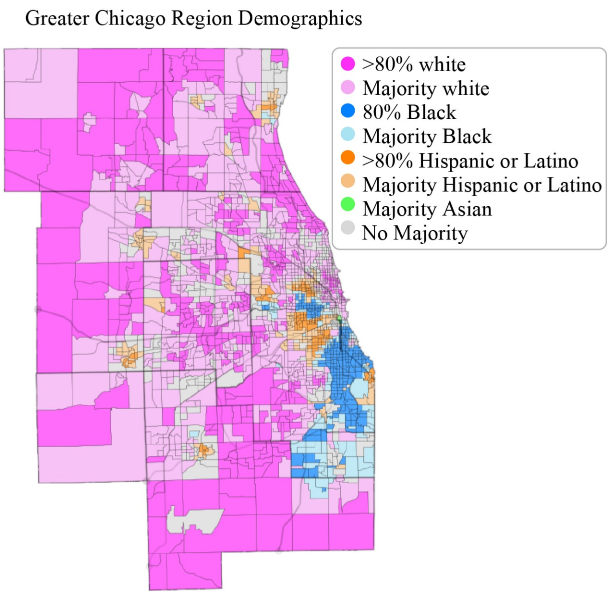
Appendix A1 WRF-CMAQ model performance of hourly simulated pollutant concentrations at 1.33 km resolution over a Midwestern domain as compared to the Environmental Protection Agency's Air Quality System observations.



Appendix A2 Census-tract level attributable mortality rates of premature all-cause mortality (per 100,000, 30 years and older) due to WRF-CMAQ simulated annualized annual changes in criteria air pollutants (a) NO_2, (b) $PM_{2.5}$, and (c) O_3 from the Advanced Clean Trucks policy adoption scenario in Illinois relative to a baseline scenario over the Greater Chicago region.



Appendix A3 WRF-CMAQ simulated annualized mean (August and October 2018, January and April 2019) volatile organic compounds (VOC) to NO$_x$ ratios for (first column) baseline scenario, (second column) 100% zero-emission MHDVs scenario, and (third column) Illinois Advanced Clean Trucks policy scenario over the Greater Chicago region (Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will Counties).



Appendix A4 Census-tract level composition race and ethnicity for majority, greater than 50%, and super majority, greater than 80%, for the Greater Chicago region.

Electronic Filing: Received,Clerk's Office 05/05/2025

April 28th, 2025

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Submitted via email to Clerk Don Brown (Don.Brown@illinois.gov)

Re: Proposed Clean Car and Truck Standards (R2024-017)

To the members of the Pollution Control Board:

My name is Brian Urbaszewski, and I serve as the Director of Environmental Health Programs at Respiratory Health Association (RHA), a Chicago-based public health nonprofit dedicated to preventing lung disease, promoting clean air, and improving lives through education, research, and policy advocacy. Last September, I submitted prefiled testified in this matter in strong support of all three Proposed Rules. With over 30 years of experience in environmental policy—including more than 25 years in my current role—I have played a lead role in RHA's advocacy efforts before the Illinois General Assembly, the Illinois Environmental Protection Agency (IEPA), and the Illinois Commerce Commission (ICC) to address a wide range of air quality and public health concerns, and am thus well qualified to speak to the readiness of Illinois to adopt the Proposed Rules.

Section V of my prefiled testimony is titled, "Public and Private Investments in Electric Vehicles In-State Make Illinois Ready for the Rules." In that section, I testified "to the significant investments in recent years in light-, medium-, and heavy-duty charging infrastructure by the federal government, state of Illinois, and regulated utilities."[1] Today, I submit the following comment to provide factual updates related to trends and programs addressed in my prefiled testimony, which continue to demonstrate that Illinois is in a strong position to adopt the Proposed Rules. Not only does the State of Illinois remain committed to cleaner transportation, but, furthermore, funding for these electrification commitments remains largely intact, available, and ready for deployment despite broader federal funding uncertainty caused by the current federal administration.

In my original testimony, I discussed how Illinois is already laying the groundwork for successful implementation of Proposed Rules through substantial investments in electric vehicle (EV) charging infrastructure. These investments come from all levels of government and include private sector support as well. I highlighted the hundreds of millions of dollars committed by the state of Illinois, including funding through the Climate and Equitable Jobs Act (CEJA), from the

Volkswagen Environmental Mitigation Trust fund (the "VW settlement," created from a comprehensive multi-state settlement with Volkswagen over Clean Air Act violations), and the Illinois state budget – none of which can be threatened by the current federal administration. I also emphasized the contributions of regulated utilities like ComEd and Ameren through the state-mandated Beneficial Electrification Plan process. In addition, I discussed how major private companies, public agencies, and school districts are independently investing in electric vehicle fleets and infrastructure.

In this comment, I provide up-to-date perspective and information that shows Illinois has both the state policy framework and financial resources to move forward confidently with EV adoption, with or without additional federal support from the current administration.

Since the Rule Proponents' regulatory proposal was submitted last June, Illinois has remained firmly committed to expanding its EV charging network—guided by clear goals, strong partnerships, and broad public support – without effect from what goes on in Washington. The Board should move forward in confidence, too, in part because funding mechanisms in Illinois remain largely intact and insulated from federal disruptions while the public health effects of vehicle pollution remain a pernicious and deadly public health crisis.

The Rule Proponents' regulatory proposal anticipated several key investments in EV charging infrastructure; overwhelmingly, these projects remain on solid financial footing. **The following projects, mentioned in my Prefiled Testimony, have firmly secured federal funding:**

- The $14.9 million awarded to the Illinois Finance Authority through the Illinois Department of Transportation (IDOT) from federal Charging and Fueling Infrastructure (CFI) funds for public EV charging is fully obligated and available to be spent.[2]
- The $7.1 million awarded to the Illinois Department of Transportation through the Federal Highway Administration's Electric Vehicle Charger Reliability and Accessibility Program to repair, replace or upgrade an estimated 93 Level 2 ports and 34 Direct Current Fast Charging (DCFC) ports across the state is firmly in place.[3]
- After announcing the availability of $50m in a Notice of Funding Opportunity in March 2024, $25.3 million in National Electric Vehicle Infrastructure (NEVI) funds were awarded by Governor Pritzker in September 2024 as grants to build charging stations along interstate corridors through the initial round of funding made available

[2] State of Ill., "Gov. Pritzker Announces $14.9M in Federal Funding for Illinois' Community Charging Program," (Jan. 11, 2024), https://www.illinois.gov/news/press-release.29498.html; *see also* Rule Proponents' Prefiled Testimony at 135 n. 11.
[3] Ill. Dep't of Transp., "IDOT awarded $7.1 million in federal funds to fix, replace electric vehicle chargers across state," (Jan. 19, 2024), https://idot.illinois.gov/news/press-release.29534.html; *see also* Rule Proponents' Prefiled Testimony at 136 n. 18.

from the NEVI Program.[4] A total of 37 projects throughout the state were chosen in this first round of NEVI funding, which will facilitate the construction of 182 new fast charging ports. IDOT initiated the round 2 funding process for NEVI in November 2024 and closed the submission of applications on January 31, 2025. Though there are administrative and timing questions related to the disbursement of NEVI funds to which Illinois has a statutory entitlement, only that NEVI funding awarded for Fiscal Year 2026 – the final year of Illinois' five-year award – are not committed with certainty to Illinois.[5]

Even in areas where future federal funding streams remain in flux, recent developments suggest continued optimism for Illinois. Based on my personal conversations with staff at IEPA responsible for administering grant programs, such as those related to EV purchase support and charging buildout, **the following funds either continue to be available or are expected to be available shortly:**

- In the past two weeks, state officials met with the U.S. EPA regarding the $115 million portion of the $430 million Climate Pollution Reduction Grant awarded to Illinois in June 2024—funding referenced in my prefiled testimony.[6] Based on those discussions, the state appears well-positioned to begin putting that money to use in the near term.

- In Illinois, the U.S. EPA Clean School Bus Program is poised to replace 450 diesel school buses. At the time of Rule Proponents' regulatory proposal, organizations and school districts in Illinois had received over $169 million in funds.[7] Round 3 Clean School Bus Program funds have started appearing in other states, and I understand from personal communication that Illinois is expected to receive further awards from that round of funding soon.

Additionally, the U.S. EPA awarded Illinois a total of $95 million through the Clean Ports Program in late 2024.[8] Based on my conversations with funding administrators at IEPA

[4] Ill Dep't of Transp., "Gov. Pritzker Announces $25.3 Million Investment in Electric Vehicle Charging Infrastructure", (Sep. 9, 2024), https://illinois-department-of-transportation.prezly.com/gov-pritzker-announces-253-million-investment-in-electric-vehicle-charging-infrastructure. *See* Rule Proponents' Prefiled Testimony at 135 n. 11, *citing* Ill. Dep't of Transp., Notice of Funding Opportunity, (Mar. 2024), https://idot.illinois.gov/content/dam/soi/en/web/idot/documents/transportation-system/planning/driveelectric/IDOT_NEVI_NOFO_FINAL.pdf, for reference to the March 2024 announcement of $50 million in funding.

[5] *See* U.S. Dep't of Transp., Letter to State Department of Transportation Directors (Feb. 6, 2025), https://www.fhwa.dot.gov/environment/nevi/resources/state-plan-approval-suspension.pdf.

[6] Ill. EPA, "State of Illinois: Climate Pollution Reduction Grant Implementation Grant," (April 1, 2024), https://epa.illinois.gov/content/dam/soi/en/web/epa/topics/climate/documents/soi-cprg-implementation-grant.pdf ("Ill. EPA CPRG"); *see also* Rule Proponents' Prefiled Testimony at 136 n. 13.

[7] U.S. EPA, Clean School Bus Program, (May 29, 2024), https://www.epa.gov/cleanschoolbus. *See also* U.S. EPA, Clean School Bus Program Awards, (May 30, 2024), https://www.epa.gov/cleanschoolbus/cleanschool-bus-program-awards. *See also* Rule Proponents' Proposed Clean Car and Truck Standards, Statement of Reasons at 58.

[8] State of Ill., "Gov. Pritzker Joins U.S. EPA to Announce Clean Energy and Pollution Reduction Grants for Illinois," (Nov. 15, 2024), https://gov-pritzker-newsroom.prezly.com/gov-pritzker-joins-us-epa-to-announce-clean-energy-and-pollution-reduction-grants-for-illinois.

earlier this month, the Notice of Funding Opportunity for this award is drafted and soon to be announced, meaning IEPA is preparing to distribute this money shortly.

To the best of my knowledge, the only previously awarded federal funding which is uncertain to be received is related to the Charging and Fueling Infrastructure grant program (CFI program) administered by the U.S. Department of Transportation (DOT). Previously, the U.S. DOT awarded $100 million to IEPA and $14 million to the Metropolitan Mayors Caucus for a total award of $114 million to support new electric vehicle charging stations across Illinois.[9] Since this additional federal funding award was announced on January 10th, 2025, it postdates my testimony and was not among the resources mentioned therein. Based on recent conversations I've had with the Illinois recipients of this funding, a funding agreement has not been finalized and there is thus no mechanism yet for IEPA or the Mayors Caucus to access these funds. **However, the complementary $39 million awarded in state funding through the Driving a Cleaner Illinois Program, slated to build 1,476 charging stations at 242 locations in Illinois, is not tied to federal grants and remains fully available.**

Importantly, there are a number of investments that have been made by the state of Illinois and regulated utilities that are entirely immune from the federal administration. For example, the following investments by the state and utility companies remain active and funded:

- Illinois has made a commitment of $70 million in state capital funds to EV charging grants.[10]
- VW Settlement funding is not connected to the federal budget process and remains completely undisturbed. Not only do previous awards of VW Settlement money continue to fund EV-related infrastructure projects, such as IEPA's award of $12.6 million for an initial wave of EV chargers,[11] but additional funding continues to be awarded from this source. For example, on February 7, 2025, the IEPA released $58 million in VW settlement funds to CTA and Pace to purchase 57 electric transit buses,[12] and on March 19, 2025, the agency made an additional $20 million in VW settlement funding available to replace Class 4–8 trucks with electric models.[13]
- CEJA requires, by statute, that utility companies develop Beneficial Electrification (BE) Plans every three years which include significant investments by utilities in EV charging equipment.[14] I previously noted that, through the CEJA Beneficial Electrification Plan (BE Plan), ComEd made $5 million available in February 2024—

[9] State of Ill., "Gov. Pritzker Announces New Electric Vehicle Charging Wins for Illinois," (Jan. 10, 2025), https://gov-pritzker-newsroom.prezly.com/gov-pritzker-announces-new-electric-vehicle-charging-wins-for-illinois.
[10] Pub. Act 101-0029, 101st Gen. Assemb., (Ill. 2019); *see also* Rule Proponents' Prefiled Testimony at 135 n. 11.
[11] John Pletz, "Illinois EPA awards $12.6M to build initial wave of EV chargers," (June 5, 2023), https://www.chicagobusiness.com/technology/illinoisepa-awards-126m-build-ev-chargers; *see also* Rule Proponents' Prefiled Testimony at 135 n. 11.
[12] David Struett, "CTA, Pace get jolt to electric bus fleets with new state EPA grant to buy 57 battery-powered vehicles" (Feb. 7, 2025) https://chicago.suntimes.com/transportation/2025/02/07/electric-bus-cta-pace-illinois-epa-pritzker.
[13] State of Ill., "llinois EPA Announces $20 Million Notice of Funding Opportunity for Electric Class 4-8 Local Freight Trucks" (March 19, 2025), https://gov.illinois.gov/news/press-release.31052.html.
[14] 20 ILCS 627/45.

and has another $5 million approved for 2025—for consumer rebates toward residential EV charger installations, while also offering $30 million in 2024 in "make-ready" rebates to businesses and governments to support the electrical preparation needed for EV charging equipment, though not covering the chargers themselves.[15] In February 2025, ComEd announced BE program funding which includes $38 million being made available for "make-ready" rebates and $9 million available for consumer rebates toward residential EV charger installations.[16] And ComEd's next BE Plan was approved on March 27th, paving the way for additional EV and EV infrastructure funding in 2026–2028 that is independent of any federal funding decisions.[17] ComEd's Commercial and Industrial (C&I) and Public Sector EV Purchase Sub-program allocates $28.5 million per year, on average, for C&I and public sector customer rebates for the purchase of electric fleet vehicles – including medium- and heavy-duty EVs – with over $85 million allocated in total. ComEd's C&I program rebates especially help commercial and industrial purchasers to shift their medium- and heavy-duty vehicle fleets to EVs. The utility's C&I and Public Sector EV Make-Ready Sub-program budgets approximately $15.6 million per year on average for this Program (over $46 million in total). Likewise, ComEd's Residential EV Charger and Installation Program, designed to incentivize the purchase and installation of residential EV charging infrastructure, has an approved average annual budget of $3.7 million per year ($11 million in total).

- Similarly, Ameren's next BE Plan was also approved on March 27th program and includes over $50 million in total for its ChargeReady program, which provides incentives for charging equipment and its installation.[18] Residential customers, C&I customers, and schools as well as public, corridor, and transit facilities are all eligible to take service under the ChargeSmart Program. This Program also provides incentives to residential customers to cover the costs of charging equipment and installation for ChargeSmart subscribers in equity eligible areas that can cover 100 percent of installation and equipment costs. Combined, the Ameren and ComEd BE total program spending will be over $250m over the next three years of 2026-28.

In conclusion, Illinois is well-positioned to keep moving forward with an aggressive approach to the EV transition. Most funding for EV projects remains secure, even as some federal programs face delays or uncertainty. The state has strong support from both state and

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[15] Final Order, Commonwealth Edison Company Petition for Approval of Beneficial Electrification Plan, Ill. Commerce Comm'n 22-0432 & 22-0442 (cons.) (Mar. 23, 2023), at 68–69. *See also* ComEd, BE Plan, (compliance filing May 2023), https://icc.illinois.gov/downloads/public/edocket/589765.PDF. *See also* Rule Proponents' Prefiled Testimony at 137 n. 19.

[16] Business Wire, "ComEd Announces $100 Million in EV Rebates Now Available to Boost Charging and EV Adoption Across Northern Illinois" (Feb. 6, 2025), https://www.businesswire.com/news/home/20250206067707/en/ComEd-Announces-%24100-Million-in-EV-Rebates-Now-Available-to-Boost-Charging-and-EV-Adoption-Across-Northern-Illinois.

[17] Final Order, Commonwealth Edison Company Petition for Approval of Beneficial Electrification Plan, Ill. Commerce Comm'n 24-0484 & 24-0577 (cons.) (Mar. 27, 2025), https://www.icc.illinois.gov/docket/P2024-0484/documents/363213/files/636050.pdf.

[18] Final Order, Ameren Illinois Petition for Approval of Beneficial Electrification Plan 2, Ill. Commerce Comm'n 24-0494 & 24-0578 (cons.) (Mar. 27, 2025), https://www.icc.illinois.gov/docket/P2024-0494/documents/363210/files/636045.pdf.

utility programs that are not tied to federal decisions, helping ensure continued progress. With robust reliable funding, clear plans, and strong local commitment, the Board can move ahead to promulgate the Proposed Rules with confidence.

It is important to remember that the harmful emissions from vehicle tailpipes lead to harmful human health impacts and billions in economic loss every year, creating a health crisis – especially in lower-income communities and communities of color – from which the Board is authorized and obligated to protect the public.[19] Recently, an American Lung Association study gave 21 out of 23 graded Illinois counties an "F" for high ozone days, while an updated April 2025 Clean Air Task Force analysis focusing on projected 2026 emissions indicated that Illinoisians faced the second highest cancer risk from diesel soot for states within the continental U.S.[20] These are only the latest additions to a staggering body of research, analysis, and observation detailing the acute health impacts of vehicle-emitted pollutants. As the federal administration threatens to roll back existing tailpipe emissions standards,[21] the Board's responsibility to "restore, maintain, and enhance the purity of the air of this State in order to protect health, welfare, property, and the quality of life"[22] becomes all the greater. I urge the Board to adopt all three of the Proposed Rules for the sake of our state and the health of its residents.

Brian Urbaszewski

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[19] *See* Rule Proponents' Prefiled Testimony at 140-148 (my prefiled testimony discussing the negative effects of vehicle pollution in the state of Illinois based on my experience with the Respiratory Health Association).

[20] American Lung Association, *State of the Air 2025: Illinois*, https://www.lung.org/research/sota/city-rankings/states/illinois (last visited Apr. 23, 2025); *see also* American Lung Association, *State of the Air* (2025), https://www.lung.org/getmedia/5d8035e5-4e86-4205-b408-865550860783/State-of-the-Air-2025.pdf; Clean Air Task Force, *Deaths by Dirty Diesel*, https://www.catf.us/deathsbydiesel/ (last visited Apr. 23, 2025); Veronica Saltzman, Tom Walker & John Graham, *The Advanced Clean Trucks Rule Saves Lives, So Why Is Congress Trying to Axe It?*, Clean Air Task Force (Apr. 23, 2025), https://www.catf.us/2025/04/advanced-clean-trucks-rule-saves-lives-why-congress-trying-axe-it/.

[21] U.S. Envtl. Prot. Agency, *EPA Launches Biggest Deregulatory Action in U.S. History* (Mar. 12, 2025), https://www.epa.gov/newsreleases/epa-launches-biggest-deregulatory-action-us-history.

[22] 415 ILCS 5/8.

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	R2024-017
PROPOSED CLEAN CAR AND TRUCK STANDARDS	)	(Rulemaking – Air)

CERTIFICATE OF SERVICE

I, the undersigned, on affirmation state the following:

That I have served the attached Post-Hearing Comments of Hearing Witnesses Horton and Urbaszewski; and Certificate of Service, by e-mail upon the following individuals listed at the e-mail addresses indicated:

TO:

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Respectfully submitted,

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