U.C.L.A. Law Review

The Clean Air Act's Blind Spot: Microclimates and Hotspot Pollution

Ann E. Carlson

ABSTRACT

The Clean Air Act (CAA) has delivered enormous pollution reductions in its almost fifty-year history, produced huge health benefits, and saved thousands of lives. Its ambient focus has led to the almost complete elimination of lead and dramatic drops in the other pollutants it regulates. Nevertheless, the CAA has a major blind spot: small "microclimates" that contain levels of deadly pollutants that can far exceed federal standards. These hotspots contain pollutants that exacerbate asthma, increase respiratory and cardiac deaths, may cause developmental problems in children, and increase cancer risks. The most prevalent of these pollution hotspots occur in predictable patterns around heavily trafficked roads and industrial facilities. Low-income communities and communities of color are much more likely to live in polluted microclimates and suffer health effects as a result.

This Article argues that the ambient focus of the CAA, which requires the monitoring and regulation of large air districts to produce background levels of pollution that meet stringent federal standards, actually masks pollution hotspots. Residents who live in air districts that receive the imprimatur of "attainment" under the CAA may nevertheless experience air quality that is considerably worse than federal air standards. Paradoxically, residents of air districts that are out of attainment, even with extreme designations, may be breathing background air that is cleaner than residents in attainment zones who are exposed to hotspot pollution. Our regulatory system helps shape our understanding of health and safety risks, in other words, in ways that are inconsistent with scientific reality. Unfortunately, using the traditional CAA mechanisms, primarily the National Ambient Air Quality Standards (NAAQS), to regulate conventional pollutants is an awkward fit for hotspot pollution. States are the primary regulators of these pollutants, yet they have little authority over the biggest causes of hotspot pollution: cars, heavy-duty trucks, and other vehicles.

Nevertheless, the Article offers suggestions for how states and the Environmental Protection Agency (EPA) may be able to address microclimate pollution using existing statutory authority. Indeed the most effective strategy for dramatically reducing hotspot pollution, electrifying the transportation fleet, also happens to be one of the most effective ways to reduce greenhouse gas emissions. Recognizing the immediate health benefits that greening the fleet would deliver could make action on climate change mitigation more palatable.

65 UCLA L. Rev. 1036 (2018)

AUTHOR

Shirley Shapiro Professor of Environmental Law, UCLA School of Law. I thank participants in workshops at University of Denver Law School, University of Notre Dame Law School, UCLA School of Law, and the University of Colorado/Duke Law School Climate and Energy Works in Progress Workshop, David Adelman, William Boyd, Jonathan Cannon, Brigham Daniels, Sean Hecht, Bruce Huber, Sarah Krakoff, Doug Kysar, Sarah Light, Suzanne Paulsen, Jed Purdy, Noah Sachs, Seana Shiffrin, Jim Salzman, Alex Wang, and Jonathan Zasloff. I received excellent research assistance from Paul Arata and Elizabeth Kent along with the fabulous research librarians at UCLA School of Law.

TABLE OF CONTENTS

INTRODUCTION

What we see and what we can measure are often what we know and understand. In government, they are also frequently what we regulate. Consider the following. Despite huge strides in cleaning up the nation's air, children who commute to school on conventional diesel-powered school buses can face pollution levels—of black carbon, hydrocarbons, and nitrous oxides—many times higher than allowable background federal pollution standards.[1] Much of the pollution enters the inside of the buses from the tailpipe exhaust of the very vehicles in which students ride.[2] Similarly, residents of neighborhoods downwind from highways around the country—especially those with significant truck traffic—can experience highly unhealthful air quality several times during the day.[3] The time of day is not necessarily intuitive: Early morning air patterns can create air pollution plumes before many people awaken and can enter homes through open windows and vents.[4] Even the configuration of highway ramps can alter exposure amounts.[5] Residents who live near airports, as well as pedestrians, can also face elevated pollution levels. Living downwind from a small regional airport with only private plane traffic can lead to pollution levels many times higher than nearby neighborhoods outside the planes' routes.[6] Different neighborhoods within the same air basins can experience highly differential risk from exposure to air pollutants, though, again perhaps

---

1. *See* JOHN WARGO ET AL., ENV'T. & HUMAN HEALTH, CHILDREN'S EXPOSURE TO DIESEL EXHAUST ON SCHOOL BUSES 41 (2002), http://www.ehhi.org/reports/diesel/diesel.pdf (showing exposure levels on buses exceeded 100 ug/m3, significantly above the federal standard of 12.0 ug/m3); Lisa D. Sabin et al., *Characterizing the Range of Children's Air Pollutant Exposure During School Bus Commutes*, 15 J. EXPOSURE ANALYSIS & ENVTL. EPIDEMIOLOGY 377, 384–86 (2004). For a table of federal air pollution standards, see U.S. Environmental Protection Agency, NAAQS Table, https://www.epa.gov/criteria-air-pollutants/naaqs-table.
2. Sabin, *supra* note 1, at 382.
3. *See* Wonsik Choi et al., *Prevalence of Wide Area Impacts Downwind of Freeways Under Pre-Sunrise Stable Atmospheric Conditions*, 62 ATMOSPHERIC ENV'T 318, 326 (2012).
4. *See id.*
5. NEALSON WATKINS & RICHARD BALDAUF, EPA, NEAR-ROAD NO_2 MONITORING TECHNICAL ASSISTANCE DOCUMENT 38 (2012), http://www.epa.gov/ttnamti1/files/nearroad/NearRoadTAD.pdf.
6. Wonsik Choi et al., *Neighborhood-Scale Air Quality Impacts of Emissions From Motor Vehicles and Aircraft*, 80 ATMOSPHERIC ENV'T 310, 316 (2013).

counterintuitively, the risk is often largely due to vehicles rather than large industrial facilities.[7]

Stationary sources, however, can also cause problems for people within close distance of their emissions. Environmental regulators have long relied on engineering estimates—known as emissions factors—to measure the majority of stationary source emissions. Yet evidence about big, industrial sources, like oil refineries, shows that emissions can be orders of magnitude higher than official measures show.[8] And epidemiological evidence demonstrates that residents living downwind of coal-fired power plants face increased risk of cardiovascular mortality and disease.[9]

All of these individual assaults from pollution, from both mobile and stationary sources, can create pollution levels that exceed national air pollution standards or cause health problems. Yet, because of the way pollutants are monitored and measured under the Clean Air Act (CAA), the air district in which the bus, the neighborhood near the freeway or airport, the highway off-ramp, or the oil refinery are located may be considered compliant with national standards.

The scenarios described above share a common characteristic: The areas sampled are relatively small "microclimates" that due to geography, including the built environment and land use choices, create air pollution hotspots. Until relatively recent advances in monitoring and modeling capabilities, the existence of these air pollution hotspots was not well understood. Moreover,

7. *See* Shih Ying Chang et al., *A Modeling Framework for Characterizing Near-Road Air Pollutant Concentration at Community Scales*, 538 SCI. TOTAL ENV'T 905, 917 (2015) (showing that roughly half of near-road exposure comes from heavy duty engines); EPA, INTEGRATED SCIENCE ASSESSMENT FOR OXIDES OF NITROGEN—HEALTH CRITERIA, FINAL REPORT (2016) [hereinafter INTEGRATED SCIENCE ASSESSMENT FOR OXIDES OF NITROGEN] (showing that 60 percent of NO2 emissions come from mobile sources and that highest health risks are from near-road exposure); S. COAST AIR QUALITY MGMT. DIST., FINAL REPORT: MULTIPLE AIR TOXICS EXPOSURE STUDY IN THE SOUTH COAST AIR BASIN (MATES-III) (2008), http://www.aqmd.gov/home/air-quality/air-quality-studies/health-studies/mates-iii/mates-iii-final-report (showing that the vast majority of toxic emissions in the Los Angeles basin come from mobile sources).

8. *See* Daniel Hoyt & Loren H. Raun, *Measured and Estimated Benzene and Volatile Organic Carbon (VOC) Emissions at a Major U.S. Refinery/Chemical Plant: Comparison and Prioritization*, 65 J. AIR & WASTE MGMT. ASS'N 1020, 1026 (2015); *see also* Alex Cuclis, Hous. Advanced Research Ctr., *Why Emissions Factors Don't Work at Refineries and What to Do About It, Paper for EPA* (Aug. 13–16, 2012), https://www3.epa.gov/ttnchie1/conference/ei20/session7/acuclis.pdf.

9. *See* MORTON LIPPMANN ET AL., NATIONAL PARTICLE COMPONENT TOXICITY (NPACT) INITIATIVE: INTEGRATED EPIDEMIOLOGIC AND TOXICOLOGIC STUDIES OF THE HEALTH EFFECTS OF PARTICULATE MATTER COMPONENTS, RESEARCH REPORT 177, HEALTH EFFECTS INST. 173 (2013), https://www.healtheffects.org/system/files/RR177-Lippmann.pdf.

the health effects of exposure to many of the pollutants that contaminate microclimates, while generally known for many years, have come into much sharper focus as our capacity to understand exposure mechanisms has improved.

I argue in this Article that what we now know and can measure about hotspot air pollution has not caught up with how we regulate. Indeed, our current system of air pollution regulation—while enormously successful—may actually mask pollution hotspots, leaving those who are exposed to them unaware of their health risks and in some cases misleading regulators about their existence. The legal literature, too, has largely failed to recognize the implications of our new measurement capabilities. This Article attempts to fill that gap.

My central contention is that microclimate hotspots raise significant challenges to the Clean Air Act's central regulatory mechanism, the National Ambient Air Quality Standards (NAAQS), for at least two pollutants: fine particulate matter and nitrogen dioxide (NO2). Indeed, I argue that the current system of ambient air regulation contained in the NAAQS can mask bad air quality by providing an imprimatur of clean air for areas of the country that attain the standards even when microclimates within them are unhealthful. Paradoxically, though, using the NAAQS system to tighten the standards to address microclimate pollution creates its own problems. Allowing microclimate pollution to drive setting the NAAQS can distort the regulatory process and divert attention away from tightening diesel and other mobile source emissions regulations, the dominant culprits in creating pollution hotspots, and onto stationary sources. But the current regulatory system also allows stationary sources that emit unhealthful levels of pollutants to continue to do so, as long as overall ambient air pollution limits are met. As a result, tackling microclimate pollution may require new approaches that, while maintaining the NAAQS approach, begin to address its shortfalls.

To date, microclimate pollution has received very little direct regulatory attention under the Clean Air Act. The CAA instead revolves largely—though not exclusively—around the NAAQS system of regulating six common pollutants sufficiently stringently to create healthy background, or ambient, air quality across a large geographic swath.[10] The NAAQS are set at

10. I focus in this Article on microclimate pollution caused by the National Ambient Air Quality Standards (NAAQS) pollutants rather than on hazardous air pollutants (HAP). I do so because the regulatory system to regulate NAAQS differs substantially from the system to regulate HAPs, and thus, I argue, raises unique problems. For an interesting article analyzing data about hazardous air pollutants and arguing that, for the most

levels designed to protect public health, welfare, and the environment.[11] In order to ensure that the NAAQS are met, states and the federal government together regulate emissions from both stationary and mobile sources, with states taking principal responsibility for stationary sources[12] and the federal government and California—through a unique statutory role—leading in regulating mobile sources.[13]

Assuming the NAAQS are sufficiently stringent, attainment with them implies that background outdoor air in attainment areas is healthful.[14] Similarly, a NAAQS nonattainment designation signals that an area has unhealthful air quality. Yet the concept of "ambient" as implemented under the CAA is applied to precisely the opposite of microclimates. Instead, attainment is measured for large geographic areas—air districts designated by the Environmental Protection Agency (EPA) after consultation with individual states[15]—even though those areas may have very different air quality within their jurisdictional borders.[16] Furthermore, the quality of the

part, stationary sources do not cause serious risks of exposure at unhealthful levels, see David E. Adelman, *The Collective Origins of Toxic Air Pollution*: *Implications for Greenhouse Gas Trading and Toxic Hotspots*, 88 IND. L.J. 273, 277 (2013) ("Industrial sources of air toxins are geographically concentrated, but even where their emissions are the highest they rarely dominate."). For a discussion about why our monitoring system may underestimate pollutants from certain stationary sources, *see supra* note 8 and accompanying text. For the statutory text establishing the NAAQS, see 42 U.S.C. §§ 7408, 7409 (2012).

11. The Clean Air Act (CAA) treats hazardous air pollutants—designated in 42 U.S.C. § 4712 of the CAA—differently by regulating individual sources through a technology-based approach.
12. *See* 42 U.S.C. § 7410 (2012) (setting forth the State Implementation Plan process to implement national standards).
13. *See* 42 U.S.C. §§ 7521, 7543 (2012). California is given special authority to issue its own mobile sources emissions standards provided the standards are "at least as protective of public health and welfare" as the federal standards. 42 U.S.C. § 7543(b)(2). The state must receive a waiver from EPA in order to implement separate mobile source standards. For an explanation of this process and its implications for federalism, *see* Ann E. Carlson, *Iterative Federalism and Climate Change*, 103 NW. U. L. REV. 1097, 1109–28 (2009).
14. For a list of the NAAQS and an explanation of their operation, see EPA, NAAQS Table, https://www.epa.gov/criteria-air-pollutants/naaqs-table (last visited Mar. 22, 2018). The statutory provisions requiring the establishment of NAAQS are included in 42 U.S.C. § 7409 (2012).
15. 42 U.S.C. §§ 7407(b), 7407(c) (2012).
16. To be fair, the setting of the NAAQS has in recent iterations begun to take account of the risks of exposure to pollutants as a result of proximity to roadways with high vehicle intensity. In setting the most recent NAAQS for nitrogen dioxide (NO2), for example, the standard was revised to include not only an annual background standard but also to include a one-hour standard, recognizing problems of peak exposure during rush hour. *See* discussion *infra* notes 114–116.

air is designated based on a relatively small number of monitoring stations, combined with complex modeling, designed to measure that quality.[17]

The NAAQS have been extraordinarily successful in improving the quality of our ambient air, and I do not mean to diminish that accomplishment. I do, however, want to highlight how our system of NAAQS designations and our methods for measuring and modeling background air pollution raise at least two separate problems in what they signal about the relative healthful or unhealthfulness of air quality.

First, the geographic size of air districts can lead to nonattainment areas that are overinclusive in terms of their attainment designation. By relying on readings of monitoring stations in the worst part of a district, a designation of nonattainment may actually overstate how bad the air is in cleaner parts of the district.[18] The South Coast Air Quality Management District (SCAQMD) covering Southern California's notoriously dirty air is a good example. SCAQMD covers 10,743 square miles and has a population of 18 million people. Measurements from the eastern part of the district routinely show levels of pollutants significantly higher than in the western part, including in the City of Los Angeles. In 2016, for example, West Los Angeles experienced no violations of the 2008 eight-hour ozone standard, downtown Los Angeles experienced one violation, and San Bernardino experienced seventy-six

17. The requirements for district monitoring of air pollutants are contained in 40 C.F.R. § 58 (2017).

18. The NAAQS are set based on a particular measurement of a quantity of air averaged over a particular time period. In the case of carbon monoxide, for example, the primary standard (which protects human health) is divided into both a measurement averaged over eight hours (nine parts per million) and over one hour (thirty-five parts per million). Air districts that exceed the standard more than once a year are considered out of attainment. *See* EPA, NAAQS TABLES [hereinafter NAAQS TABLES], https://www.epa.gov/criteria-air-pollutants/naaqs-table [https://perma.cc/646L-AL3M] (last visited Mar. 7, 2018). For ozone, until 2015, the standard was .075 parts per million, averaged over eight hours; it has now been lowered to .070 parts per million. *See* EPA, TABLE OF HISTORICAL OZONE NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS) [hereinafter TABLE OF HISTORICAL OZONE], https://www.epa.gov/ozone-pollution/table-historical-ozone-national-ambient-air-quality-standards-naaqs [https://perma.cc/U9E9-2F8W]. The Trump Administration has indicated that it will delay the implementation of the new .070 standard by one year. *See* Timothy Cama, *EPA Delays Obama Air Pollution Rule by One Year*, HILL, (June 6, 2017), http://origin-nyi.thehill.com/policy/energy-environment/336663-epa-delays-obama-air-pollution-rule-deadline-by-one-year?amp=1 [https://perma.cc/9JRK-H2HM]. To determine whether a designated area is out of attainment, EPA takes the annual fourth-highest daily maximum eight-hour concentration and averages it over three years. *See* NAAQS TABLES, *supra* note 18. The further out of attainment an area is, the more serious the regulatory consequences.

violations.[19] Yet the entire district is designated an extreme nonattainment zone for ozone.[20] The district boundaries make regulatory sense because of the geographic configuration of the district and air patterns that typically move pollutants from the west to the east. Nevertheless, common perceptions about how bad air quality is in the City of Los Angeles can be both incorrect and misleading.

Ironically, tightening NAAQS to address microclimate pollution or mandating that monitoring stations measure microclimates might make this overinclusiveness problem worse. Take, for example, near-roadway pollution, a phenomenon well-recognized in the scientific literature. Residents living within 300 to 500 meters of major roadways—and millions of people fall within that category—experience elevated levels of air pollutants, particularly during rush hour.[21] If air districts were to rely on monitors placed to measure this elevated pollution, many could experience readings that would tip them into nonattainment areas under the NAAQS for at least two pollutants: nitrogen dioxide and fine particulate matter. Or, if EPA tightened a NAAQS in recognition of the deleterious effects of near roadway pollution—as it has done for nitrogen dioxide by adding a new short-term exposure standard[22]—more air districts would likely be out of attainment.[23] The nonattainment designation would, in turn, trigger a series of regulatory requirements for these districts aimed at attempting to bring them back into attainment.[24] Yet the most obvious option to increase the likelihood of attainment—tightening various mobile source standards—is outside the regulatory purview of forty-nine states and all local air districts and is instead

19. Cal. Air Res. Bd., Select 8 Summary, https://www.arb.ca.gov/adam/select8/sc8display.php [https://perma.cc/PR5C-3AR9] (selecting for national 2008 eight-hour ozone standard (0.075 ppm) for West Los Angeles/VA Hospital, Los Angeles N. Main and San Bernardino 4th Street).

20. *See* EPA, CURRENT NONATTAINMENT COUNTIES FOR ALL CRITERIA POLLUTANTS, https://www3.epa.gov/airquality/greenbook/ancl.html [https://perma.cc/49K8-7YC8] (last updated Feb. 28, 2018).

21. HEALTH EFFECTS INST., TRAFFIC-RELATED AIR POLLUTION: A CRITICAL REVIEW OF THE LITERATURE ON EMISSIONS, EXPOSURE, AND HEALTH EFFECTS vii–ix (2010).

22. *See* EPA, AIR QUALITY GUIDE FOR NITROGEN DIOXIDE 2, https://www3.epa.gov/airnow/no2.pdf.

23. Environmental Protection Agency (EPA) has yet to designate nonattainment areas for the short-term exposure standard. *See* EPA, NITROGEN DIOXIDE DESIGNATIONS: REGULATORY ACTIONS, https://www.epa.gov/nitrogen-dioxide-designations/nitrogen-dioxide-designations-regulatory-actions [https://perma.cc/CR4C-XKKK] ("EPA has designated all areas of the country as unclassifiable/attainment.").

24. To be sure, the new one-hour standard for nitrogen dioxide allows measurements averaged over a three-year period rather than finding a violation for a single event. *See* EPA, NAAQS TABLES, *supra* note 18.

exclusively federal with the exception of California.[25] Moreover, most other measures that might significantly control transportation emissions—particularly those measures that interfere in any meaningful way with driving—are not mandatory under the CAA. States have not been willing to impose meaningful transportation or land use controls, and the language of the CAA comes close to actively discouraging transportation control measures. The result is that a nonattainment designation likely causes states to target stationary sources, which are not the principal cause of microclimate pollution, for more stringent pollution control.

But leaving microclimates out of the monitoring system hardly makes them go away. The way in which the NAAQS system operates creates a problem of underinclusiveness that is far more troubling than the overinclusiveness problem. Using a relatively small number of monitors to measure ambient air quality over a large geographic area, by definition, simply ignores many microclimates. Again, to use the Los Angeles basin as an example, the air district uses thirty-eight monitoring stations around its almost 11,000-mile basin to measure air quality, a number higher than required by federal regulation.[26] The stations cannot, obviously, measure the quality of the air across the potentially thousands of microclimates that exist within its borders. And, indeed, EPA regulations discourage using microclimate monitoring to establish ambient limits for a number of NAAQS pollutants, including fine particulate matter. The agency has opposed environmental group efforts to require near-road monitors to measure PM 2.5.[27]

Yet microclimates around the country have air quality significantly more unhealthful than the background measurements of ambient air suggest.

25. Even air districts within California are preempted from regulating emissions from mobile sources. The U.S. Supreme Court struck down a South Coast Air Quality Management District (SCAQMD) program that mandated that operators of certain vehicle fleets purchase alternative fuel vehicles on the grounds that the rules were preempted by Section 209(a) of the CAA. *See* Engine Mfrs. Ass'n v. S. Coast Air Quality Mgmt. Dist., 541 U.S. 246, 252–59 (2004).
26. *See* RENE M. BERMUDEZ ET AL., S. COAST AIR QUALITY MGMT. DIST., ANNUAL AIR QUALITY MONITORING NETWORK PLAN 2 (2016), http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-monitoring-network-plan/annual-air-quality-monitoring-network-plan.pdf?sfvrsn=10. In addition to the thirty-eight multipollutant monitors, SCAQMD also has five monitoring sites specifically for stationary sources of lead. *Id.*
27. The monitoring regulations are contained in 40 C.F.R. § 52 app. D (2016). A coalition of environmental groups recently sued EPA over its failure to mandate near-road monitors in Southern California to establish ambient limits. *See* Brief for Petitioner at 1–3, Physicians for Soc. Responsibility v. EPA, No. 12-70016 (9th Cir. filed May 18, 2012) (on file with author). EPA opposed the placement of near-road monitors to measure PM 2.5. *See infra* note 118 and accompanying text.

This is true not only in areas of the country that are out of attainment for certain NAAQS pollutants but also in areas of the country considered to comply with Clean Air Act requirements. And it is true in some predictable, measurable ways. To put this more concretely, children who ride buses in central Los Angeles and in rural Connecticut both face in-cabin air pollution significantly dirtier than the outside ambient air.[28] People who live in neighborhoods downwind from freeways in Memphis, Las Vegas, Denver, and Detroit can breathe air that is on average significantly dirtier than ambient air in the worst nonattainment area in the country, Southern California.[29] And residents of communities near oil refineries and chemical plants in Houston, Texas and Torrance, California may be breathing pollutants at levels that exceed federal standards and yet are represented to be compliant.[30] Not surprisingly, these harms disproportionately affect low-income communities of color. National data show that Latinos, African Americans, and Asian/Pacific Islanders are much more likely to live near freeways than whites. Nearly half of near-freeway residents are poor or near-poor.[31] Residential communities surrounding refineries share similar demographics.[32]

The phenomenon I describe in this Article also raises a broader theoretical point, one not confined to air pollution. How we monitor and measure pollution—in water, on the ground, in the air—shapes not only how we regulate pollution but also cultural perceptions about health and safety in ways that do not necessarily comport with the best available scientific information. Our "ways of seeing" these pollution problems are shaped by scientific, technical, and legal practices that grant them a scientific authority that, in turn, shapes—and, in the case of microclimate pollution, limits—our regulatory response and public understanding of the health and safety risks we actually face.[33] By using seemingly authoritative emissions factors rather

28. *See* JOHN WARGO ET AL., ENVIRONMENT AND HUMAN HEALTH INC., CHILDREN'S EXPOSURE TO DIESEL EXHAUST ON SCHOOL BUSES 9–20 (2002), http://www.ehhi.org/reports/diesel/diesel.pdf.
29. *See Traffic-Related Health Impacts*, *supra* note 21, at 10 (summarizing results of studies showing that near-road pollution is elevated and causes health risks).
30. *See* discussion *infra* notes 98–100.
31. Tegan K. Boehmer et al., *Residential Proximity to Major Highways—United States*, 2010, CDC, (2013), https://www.cdc.gov/mmwr/preview/mmwrhtml/su6203a8.htm [https://perma.cc/C3KN-DQ6E] (last visited Mar. 7, 2018).
32. *See* EPA, FACT SHEET: FINAL PETROLEUM REFINERY SECTOR RISK AND TECHNOLOGY REVIEW AND NEW SOURCE PERFORMANCE STANDARDS 3, https://www.epa.gov/sites/production/files/2016-06/documents/2010-0682_factsheet_overview.pdf.
33. *See* William Boyd, *Ways of Seeing in Environmental Law: How Deforestation Became an Object of Climate Governance*, 37 ECOLOGY L.Q. 843, 847–50 (2010). For an account of

than actual measurements of refinery emissions—factors that may systematically understate the risk to residents in adjacent neighborhoods—regulators may simply have been unable to "see" or understand the complaints of residents who can smell the chemicals and regularly experience respiratory problems. By stamping an air district as "in attainment" with all six federal air standards, residents of the district may feel confident that the air they breathe is healthful, even when living close to a heavily trafficked freeway. And by labeling an air district an "extreme non-attainment zone," residents (and observers) may believe they are being poisoned, even when the air quality for many of them is healthier than the air in parts of attainment zones. In addition to identifying the problem of systematic hotspot air pollution and the role the Clean Air Act plays in its continuation, then, part of my aim in this project is to unmask the role that monitoring, measuring, and labeling air pollution play in our collective understanding of the quality of air we breathe.

I turn in Part I to describing the statutory scheme that establishes the NAAQS and its enormous public health accomplishments since its 1970 passage. I then describe our increasing understanding of the health problems that remain as the result of exposure to three of the NAAQS pollutants that remain ubiquitous: ozone, NO2, and fine particulate matter. I also describe the ways in which near-source exposure to the latter two pollutants are of particular concern, and the sources, both mobile and stationary, that cause this exposure. In Part II, I describe the monitoring system EPA requires of states, including the scale of the area to be monitored for the pollutants that cause near-source health risks. Part II also includes a discussion of three ways in which EPA is attempting to address hotspot pollution under its existing authority. In Part III, I turn to a more systematic discussion of the significant shortcomings of the NAAQS for addressing hotspot pollution despite EPA's efforts to address it. In Part IV, I describe ways in which EPA programs that are not necessarily designed to address near-source exposure nevertheless can produce significant reductions in the pollutants that cause it. In fact the single most effective way to reduce near road exposure is also one of the central means to reduce greenhouse gas emissions—cleaning up the transportation fleet with a push toward vehicle electrification. As a result, the push for climate change mitigation in the transportation sector has immediate and important health

how changes in our ability to detect toxins in the environment led to a major shift in our "ways of seeing" chemical hazards in the water, on the land, in our food, and in our workplaces, see William Boyd, *Genealogies of Risk*: *Searching for Safety, 1930s–1970s*, 39 ECOLOGY L.Q. 895, 944–77 (2012).

co-benefits that could make such regulation more politically palatable. Since that is a multi-decadal strategy, however, I also evaluate additional ways to curtail hotspots in the shorter term, including through transportation measures and land use controls. I conclude by suggesting that Clean Air Act reform may be necessary to address hotspot pollution meaningfully in the shorter and medium term.

I. SETTING NAAQS, EVALUATING THE PUBLIC HEALTH EFFECTS OF POLLUTION EXPOSURE

A. The NAAQS Statutory Framework

The central—though not only—means for cleaning up the nation's air has been through the National Ambient Air Quality Standards.[34] Although familiar to many, a recitation of the ways in which the NAAQS system operates helps set the stage for understanding how the system can both produce dramatically cleaner air and mask the deleterious health effects of certain pollutants that concentrate in small geographic areas.

The Environmental Protection Agency sets NAAQS for pollutants that "endanger public health and welfare" and that are emitted by numerous types of sources.[35] To date, six pollutants have been designated as NAAQS pollutants: lead, carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter, which is further broken down into particulate matter, known as PM 10 (for particles that are between 10 and 2.5 microns in size), and fine particulate matter, known as PM 2.5 (for particles smaller than 2.5 microns).[36]

The process for designating, and then updating, a pollutant regulated under the NAAQS provisions is set forth in Sections 108 and 109 of the CAA. In addition to the requirements that a pollutant "endanger public health and welfare" and come from ubiquitous sources, Section 108 requires the administrator to issue criteria documents that assess the latest scientific evidence about the health and welfare effects of exposure to the pollutant.[37] Section 109 requires that the EPA Administrator appoint an independent scientific review committee to assist in the promulgation of NAAQS and that

34. 42 U.S.C. §§ 7408, 7409 (2012).
35. *Id.* § 7408(a)(1)(A)–(B).
36. *See Criteria Air Pollutants*, EPA, https://www.epa.gov/criteria-air-pollutants [https://perma.cc/BG4P-VZJU] (last visited April 14, 2018).
37. 42 U.S.C. § 7408(a)(2).

the NAAQS be reevaluated and revised every five years with the assistance of the committee.[38] Based on the evaluation of the scientific data about the health and welfare effects of pollution exposure, NAAQS "shall be ambient air quality standards the attainment and maintenance of which in the judgment of the Administrator, based on such criteria and allowing an adequate margin of safety, are requisite to protect the public health."[39]

Ambient air standards apply to geographic units known as air quality control regions (AQCRs). EPA first designated a number of AQCRs in the 1960s, as the federal government began to expand its role in regulating air pollution; Section 107 of the CAA recognizes the pre–1970 AQCRs and provides authority to EPA to designate air regions for purposes of compliance with the NAAQS.[40] As an early EPA document about the designations explains, the regions were to be based on "jurisdictional boundaries, urban-industrial concentrations, and other factors, including atmospheric areas, necessary to provide adequate implementation of air quality standards."[41] States have the primary responsibility for "assuring air quality within the entire geographic area comprising such State" while EPA is responsible for determining whether air districts comply with the NAAQS.[42] The EPA Administrator designates districts as either attainment, nonattainment, or unclassifiable depending on whether they meet the standard, do not meet the standard, or lack the requisite information to determine attainment status.[43]

B. Air Pollution Accomplishments

Since the first NAAQS were promulgated shortly after the passage of the modern CAA in 1970, the progress the United States has made in cleaning up the air is remarkable. Despite the fact that systematic evidence of hotspot pollution exists, these accomplishments deserve highlighting. Over the last forty-five years, emissions of the six pollutants regulated under the NAAQS program have dropped by close to 70 percent.[44] EPA estimates that the 1990 amendments to the Clean Air Act will have saved more than 230,000 lives by

38. *Id.* § 7409(d)(1)–(2).
39. *Id.* § 7409(b)(1).
40. *Id.* § 7407.
41. EPA, FEDERAL AIR QUALITY CONTROL REGIONS 1 (1972), https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P10054HI.TXT.
42. § 7407(a)–(b), (d)(1)(B) (2012).
43. § 7407(c)–(d) (2012).
44. *See* EPA, OVERVIEW OF THE CLEAN AIR ACT AND AIR POLLUTION, http://www.epa.gov/air/caa/progress.html#breathe [https://perma.cc/KSY3-4ELZ].

2020, reduced 2.4 million cases of asthma exacerbation, and prevented 17 million sick days.[45] For some pollutants, including lead and sulfur dioxide, only a handful of counties across the country are out of attainment with the standard.[46] Lead has been almost completely eliminated as an air pollutant, with a 98 percent reduction in airborne lead between 1980 and 2014.[47] And for carbon monoxide, the entire country has attained the NAAQS.[48] These accomplishments are all the more impressive given U.S. economic[49] and population growth[50] during that time period.

C. Remaining Health Effects From Pollution Exposure

Significant evidence has mounted over the years, however, that three NAAQS pollutants—PM 2.5, ozone, and nitrogen dioxide (NO2)—continue to cause persistent and ubiquitous health problems and increases in morbidity.[51] Two of those pollutants, fine particulate matter and NO2, can be

---

45. *See* EPA, BENEFITS AND COSTS OF THE CLEAN AIR ACT, 1990–2020, THE SECOND PROSPECTIVE STUDY, https://www.epa.gov/clean-air-act-overview/benefits-and-costs-clean-air-act-1990-2020-second-prospective-study [https://perma.cc/54LE-MGKS].

46. *See* EPA, LEAD (2008) DESIGNATED AREA/STATE INFORMATION [hereinafter LEAD 2008 STANDARD NONATTAINMENT AREAS], https://www3.epa.gov/airquality/greenbook/mbtc.html (last updated Feb. 28, 2018); EPA, SULFUR DIOXIDE (2010) DESIGNATED AREA/STATE INFORMATION [hereinafter SULFUR DIOXIDE 2010 STANDARD NONATTAINMENT], https://www3.epa.gov/airquality/greenbook/tbtc.html (last updated Feb. 28, 2018). As the 2008 Sulfur Dioxide Integrated Science Assessment explained, "[n]o monitored exceedance of the SO_2 annual ambient air quality standard in the lower 48 States of the U.S. has been recorded between 2000 and 2005, according to the EPA Acid Rain Program (ARP) 2005 Progress Report." EPA, INTEGRATED SCIENCE ASSESSMENT FOR SULFUR OXIDES—HEALTH CRITERIA 2–23 (2008) [hereinafter INTEGRATED SCIENCE ASSESSMENT FOR SULFUR OXIDES].

47. EPA, BASIC INFORMATION ABOUT LEAD AIR POLLUTION, https://www.epa.gov/lead-air-pollution/basic-information-about-lead-air-pollution [https://perma.cc/TL2R-ZRFX] (last visited Mar. 8, 2018).

48. *See* EPA, CARBON MONOXIDE (1971), DESIGNATED AREA/STATE INFORMATION, https://www3.epa.gov/airquality/greenbook/cbtc.html (last updated Feb. 28, 2018).

49. The U.S. economy has grown by 80 percent since 1970 as measured by adjusted GDP. *See* DATA 360, GDP-REAL (ADJUSTED) UNITED STATES, http://www.data360.org/dataset.aspx?Data_Set_Id=354 [https://perma.cc/9FTR-UDZV].

50. The U.S. population grew from 205 million in 1970 to 316 million in 2013. *See* U.S. POPULATION BY YEAR, http://www.multpl.com/united-states-population/table [https://perma.cc/C3XL-RPAY].

51. This is not to suggest that the other three NAAQS pollutants cause no health problems, but rather that their airborne levels have dropped dramatically enough that exposure levels are causing less concern than for the remaining three. *See, e.g.*, INTEGRATED SCIENCE ASSESSMENT FOR SULFUR OXIDES, *supra* note 46, at 2–53 ("Because SO2 concentrations have declined markedly over the past few decades, relatively few recent personal exposure studies have focused on SO2.").

elevated near the sources from which they are emitted and can cause significant health problems for those breathing in the pollutants. Ozone, by contrast, can be elevated in areas away from the primary sources, and thus the system of NAAQS regulation is better suited for its control. Nevertheless, nitrogen dioxide (along with other NOx and volatile organic compounds) contributes to the formation of ground-level ozone so that better control of NO2 will lead to lower ozone levels.[52] And two NAAQS—nitrogen dioxide and sulfur dioxide—can transform in the atmosphere into PM 2.5.[53] The ongoing control of all four of these NAAQS, then, is key to reducing the ongoing negative health effects of air pollution.

Since the passage of the contemporary Clean Air Act in 1970, our scientific understanding of air pollution has significantly improved in two important ways relevant to my analysis. First, we have much better data about the specific health effects of particular pollutants at particular exposure levels. Second, we can measure individual exposure to pollutants in much smaller spaces more precisely. Our regulatory structure to control air pollution, however, has not caught up to these improvements in scientific knowledge.

A number of long-term studies have found a strong relationship between exposure to particular pollutants and increased risk of mortality, and all show that the risk of mortality increases with higher levels of exposure to the particular pollutant.[54] Perhaps the most striking new finding about the

52. EPA, OZONE POLLUTION [hereinafter OZONE POLLUTION], https://www.epa.gov/ozone-pollution [https://perma.cc/JT8J-GWXN] (last visited Mar. 8, 2018); EPA, NITROGEN DIOXIDE BASICS [hereinafter NITROGEN DIOXIDE BASICS], https://www.epa.gov/no2-pollution/basic-information-about-no2 [https://perma.cc/NLN5-K27X] (last visited Mar. 8, 2017). NO2 is one of seven compounds that make up NOx and the only one of the seven that is separately regulated from ozone. NO2 is the most prevalent of the seven NOx compounds. *See* EPA, TECHNICAL BULLETIN, NITROGEN OXIDES (NOX): WHY AND HOW THEY ARE CONTROLLED 1 (1999).

53. EPA, INTEGRATED SCIENCE ASSESSMENT FOR PARTICULATE MATTER 1–4 (2009) [hereinafter ASSESSMENT FOR PARTICULATE MATTER]. *See* INTEGRATED SCIENCE ASSESSMENT FOR OXIDES OF NITROGEN, *supra* note 7, at lxxiii.

54. *See* Johanna Lepeule et al., *Chronic Exposure to Fine Particles and Mortality: An Extended Follow-up of the Harvard Six Cities Study From 1974 to 2009*, 120 ENVTL. HEALTH PERSP. 965, 967 (2012) (showing that exposure to fine particulate matter increases the risk of mortality from cardiac disease and lung cancer and that "[e]ach 10-μg/m^3 increase in PM 2.5 was associated with a 14% increased risk of all-cause death . . . a 26% increase in cardio-vascular death . . . and a 37% increase in lung-cancer death"); Michelle C. Turner et al., *Long Term Ozone Exposure and Mortality in a Large Prospective Study*, 193 AM. J. RESPIRATORY & CRITICAL CARE MED. 1134, 1139 (2016) ("We observed significant positive associations between long-term O_3 and all-cause, circulatory, and respiratory mortality with 2% , 3%, and 12% increases in risk per 10 ppb, respectively, in this large-scale study . . . ."); Annunziata Faustini et al., *Nitrogen*

health effects of air pollution is that populations exposed to two of the most ubiquitous pollutants—ozone and PM 2.5—face increased risk of death even at rates lower than the current stringent federal standards. In a remarkably comprehensive study, researchers looked at 61 million Medicare enrollees from across the country, including in less populated (and less frequently studied) parts of the country.[55] They broke the study group down by 1 x 1 km geographic areas. For every increase in average annual exposure of 10 micrograms of PM 2.5 per cubic meter, the mortality rate among Medicare enrollees increased 7.3 percent. Increases of 10 parts per billion of ozone caused less significant, but still real, increases in mortality rates. Surprisingly, for people exposed to levels below the fine particulate matter federal standard, the increase in mortality rate was even larger: For every increase of 10 micrograms per cubic meter of PM 2.5, mortality increased by 13.6 percent.[56]

We also know that exposure to specific air pollutants causes particular health effects in addition to increased risk of death. In the Environmental Protection Agency's most recent PM 2.5 Integrated Scientific Assessment—which comprehensively reviews and assesses the evidence of the health effects of pollutant exposure—the agency concluded that short-term exposure to PM 2.5 causes cardiovascular effects, likely causes respiratory ailments, and causes premature mortality. Long-term exposure has the same effects and even more, with evidence suggesting that exposure is related to reproductive harm, developmental problems in children, and cancer.[57]

Dioxide and Mortality: Review and Meta-Analysis of Long-Term Studies, 44 EUR. RESPIRATORY J. 744, 751 (2014) (showing that exposure to nitrogen dioxide increases overall cardiovascular and respiratory mortality, explaining how the results hold independent of multiple pollutant exposure, including fine particulates, and concluding that "NO_2 effects ranging from 3% to 36% per 10 μgm^{-3} have been reported for cardiovascular mortality in European cohorts as well as an effect of 12% for respiratory mortality").

55. *See generally* Qian Di et al., *Air Pollution and Mortality in the Medicare Population*, 26 NEW ENG. J. MED. 2513 (2017).

56. *Id.* at 2513.

57. *See* ASSESSMENT FOR PARTICULATE MATTER, *supra* note 53, at 2–9. EPA conducts a comprehensive Integrated Science Assessment every time it reviews whether to strengthen a NAAQS. For a description of the process, see EPA, LEARN ABOUT THE ISAS, https://www.epa.gov/isa/learn-about-isas (last visited Mar. 8, 2018). The team conducts an extensive review of existing evidence about the health effects of the pollutant being reviewed and then characterizes the strength of the evidence about particular effects. For some health effects, for example, EPA concludes that there is evidence "sufficient to conclude there is a causal relationship" between exposure to the pollutant and the particular health effect. For others, EPA might find that the evidence is "suggestive of a causal relationship" but not sufficient to infer one. *See* ASSESSMENT FOR PARTICULATE MATTER, *supra* note 53, at 1–21. *See also* Lepeule, *supra* note 54, at 965 (showing that

The improvement in our understanding of the health effects of exposure to fine particulate matter since the 1970 passage of the CAA is quite remarkable. The earliest federal standard regulated only "Total Suspended Particles" (TSP) without regard to particle size. As of 1982, when EPA prepared air quality criteria documents for TSP, the agency concluded that "essentially no epidemiological studies" provided sufficient data to connect "respiratory disease or other types of mortality to chronic (annual average) exposures to PM . . ."[58] The same document did acknowledge that health effects "might most reasonably and directly [be] attributed to fine- and small coarse-mode particles" but also found very little evidence of health effects for exposure even at levels that far exceed what we now know to be highly unhealthful.[59] It was not until 1997 that EPA established a separate NAAQS for fine particulate matter. The new fine particulate standard was set because data from six cities indicated that "[f]ine particles (PM 2.5) showed a consistent and statistically significant relationship to acute mortality" with risks increasing as levels of fine particulates increased.[60] By 2012, the standard had been tightened twice, with the most recent standard set based on the evidence described above of substantial health risks at exposure levels far below what was previously understood.[61]

Our knowledge of the health effects of ozone exposure has increased dramatically as well. We now know that short-term ozone exposure causes respiratory effects and likely causes cardiovascular effects and increases in morbidity, according to EPA's 2013 Integrated Scientific Assessment.[62] Evidence suggests that short-term ozone exposure causes central nervous system effects as well. Additionally, researchers have found associations between short-term exposure and increased hospital visits and increased allergic and asthma-related responses.[63] Epidemiological evidence also exists

exposure to fine particulate matter increases the risk of mortality from cardiac disease and lung cancer).

58. *See* EPA, AIR QUALITY CRITERIA FOR PARTICULATE MATTER AND SULFUR OXIDES 1-97 (Dec. 1982).
59. *Id.* at 1-92, 1-99, 1-103.
60. *See* EPA, AIR QUALITY CRITERIA FOR PARTICULATE MATTER 1-13 (1996).
61. *See* EPA, PARTICULATE MATTER (PM STANDARDS)—TABLE OF HISTORICAL PM NAAQS, https://www3.epa.gov/ttn/naaqs/standards/pm/s_pm_history.html [https://perma.cc/J8CY-VF34] (last visited Mar. 7, 2018).
62. *See* EPA, INTEGRATED SCIENCE ASSESSMENT FOR OZONE AND RELATED PHOTOCHEMICAL OXIDANTS, at 1-5, 2-20 to 2-24 (Feb. 2013) [hereinafter ASSESSMENT FOR OZONE AND RELATED PHOTOCHEMICAL OXIDANTS], https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=247492; *see also* Turner et al., supra note 54, at 1134, 1139., 193 AM. J. RESPIRATORY & CRITICAL CARE MED. 1134, 1139 (2016).
63. *Id.*

showing that short-term exposure is associated with pulmonary inflammation and lung host defenses. Long-term exposure to ozone is connected to similar health outcomes, though the evidence for causation of many of the health outcomes is somewhat weaker for longer term exposure as opposed to shorter term.[64] Health effects from ozone exposure appear to be worse for children, older adults, outdoor workers, and individuals with asthma.[65] Some evidence—still suggestive—exists showing that individuals who are obese and those of lower socioeconomic status may also suffer worse health outcomes.[66] Women, Latinos, and African Americans may as well, though more study is needed.[67]

The sum total of the scientific knowledge of the health effects of ozone, in 1971, by contrast, was described in the Federal Register notice announcing the final adoption of the first standards: "The revised national primary standard . . . is based on evidence of increased frequency of asthma attacks in some asthmatic subjects on days when estimated hourly average concentrations of photochemical oxidant reached . . . 0.10 ppm."[68]

Exposure to NO2 also produces negative health outcomes. In EPA's most recent Integrated Scientific Assessment of Oxides of Nitrogen, the agency concluded that short-term exposure to NO2 likely causes respiratory ailments and may cause cardiovascular disease. Long-term exposure likely causes respiratory disease and may cause increases in cancer, low birth weight, and cardiovascular effects.[69] Vulnerable populations include children, the elderly, and people with asthma.[70]

---

64. *See id.* at 1-5.
65. *See id.* at 1-8, 8-11 to -15, 8-18 to -23.
66. *See id.* at 8-26 to -27, 8-30 to -31.
67. *See id.* at 8-24 to -26, 8-28 to -29.
68. National Primary and Secondary Ambient Air Quality Standards, 36 Fed. Reg. 8186 (Apr. 30, 1971) [hereinafter Ambient Air Quality Standards]; *see also* Faustini et al., *supra* note 54, at 751 (exposure to nitrogen dioxide increases overall cardiovascular and respiratory mortality and explaining how the results hold independent of multiple pollutant exposure, including fine particulates). In its most recent Integrated Science Assessment of Oxides of Nitrogen, EPA concluded that evidence of exposure to NO2 is suggestive of, but insufficient to establish definitively, a relationship between short- and long-term exposure and mortality. *See* INTEGRATED SCIENCE ASSESSMENT FOR OXIDES OF NITROGEN, *supra* note 7, at lxxxii.
69. For a chart describing EPA's conclusions about the relationship between NO2 exposure and health effects, see INTEGRATED SCIENCE ASSESSMENT FOR OXIDES OF NITROGEN, *supra* note 7, at lxxxii.
70. *See* EPA, REVIEW OF THE PRIMARY NATIONAL AMBIENT AIR QUALITY STANDARDS FOR NITROGEN DIOXIDE: RISK AND EXPOSURE ASSESSMENT AND PLANNING DOCUMENT 1–8 to 8–9 (May 2015) [hereinafter REVIEW OF THE PRIMARY NATIONAL AMBIENT AIR QUALITY

Again in contrast to the most recent EPA assessment, in 1971 EPA eliminated a short-term standard for NO2 (while retaining an annual standard) on the grounds that "[n]o adverse effects on public health or welfare have been associated with short-term exposure to nitrogen dioxide at levels which have been observed to occur in the ambient air."[71] In 2013, in a complete turnaround, EPA added to its annual standard a new short-term exposure standard based on the scientific information demonstrating respiratory and other health effects from near-source exposure.[72]

II. EVIDENCE OF NEAR-SOURCE EXPOSURE

A. Mobile Sources

Not only do we have a much better understanding of the negative health effects of exposure to ozone, PM 2.5, and NO2, we also know significantly more about where and how human exposure occurs. For some pollutants—ozone being the most important—exposure is not tied to living or working near the sources of ozone pollutants. Ozone is a secondary pollutant, one that occurs as the result of the emission of "ozone precursors"—volatile organic compounds (VOCs) and nitrogen oxides (NOx)—that chemically react with sunlight to cause ground level-ozone.[73] Once ozone is formed, those who experience the highest levels of ozone exposure are downwind from the sources, sometimes at significant distances. They are typically suburban and rural residents who live downwind of urban, industrialized areas.[74]

For particulate matter and NO2 emissions, however, near-source exposure matters a great deal. And significant evidence exists that one source in particular, traffic on major roads and highways, is the largest culprit of near-source pollution.

In a 2010 comprehensive review of studies of exposure to traffic-related air pollution, a high-level panel tasked with evaluating the literature concluded that those living within 300 to 500 meters of a major roadway face

STANDARDS FOR NITROGEN DIOXIDE] (reviewing Integrated Science Assessment evidence of health effects of short-term nitrogen dioxide exposure).

71. *See* Ambient Air Quality Standards, *supra* note 68, at 8186.
72. *See* REVIEW OF THE PRIMARY NATIONAL AMBIENT AIR QUALITY STANDARDS FOR NITROGEN DIOXIDE, *supra* note 70, at 1-3.
73. *See* ASSESSMENT FOR OZONE AND RELATED PHOTOCHEMICAL OXIDANTS, *supra* note 62, at 1-2.
74. *See id.*

the highest health risks from traffic emissions.[75] There is significant evidence, the panel concluded, that near-road exposure exacerbates asthma and suggestive evidence that living near a major roadway causes asthma, increases respiratory symptoms that are non-asthma related, impairs lung function, increases cardiovascular mortality, and increases overall mortality from all causes.[76]

The most recent Integrated Science Assessment for NO2 actually labels NO2 a "traffic-related pollutant," noting that "recent information shows that motor vehicle emissions are the largest single source of NO2 in the air and that NO2 concentrations tend to be variable within communities, decreasing with increasing distance from roads."[77] NO2 concentrations also vary depending, unsurprisingly, on traffic conditions, with rush hour traffic, areas of traffic delay, and so forth exhibiting higher emissions than areas with freer flowing traffic.[78]

Near-road PM 2.5 exposure also causes real and significant health effects. Traffic combustion generates significant particulate matter, especially fine and ultrafine particles, and "particulates generated from combustion processes, especially diesel exhaust particulates (DEP), are more potent in posing adverse health effects than those from non-combustion processes."[79] A recent study of two roadways in the United States showed that heavy-duty diesel contributes more than half of fine particulate matter and NOx (including NO2) and thatconcentrations of these pollutants drop dramatically 200 meters away from the roads. Light-duty vehicles are a significant source of other pollutants, including benzene.[80]

More than 11 million Americans live within 150 meters of a major highway.[81] Though this is just under 4 percent of the U.S. population, in urban areas the percentage rises dramatically. In Los Angeles, for example,

75. *See* HEALTH EFFECTS INST., *supra* note 21, at 5.
76. *See* HEALTH EFFECTS INST., *supra* note 21, at 10.
77. INTEGRATED SCIENCE ASSESSMENT FOR OXIDES OF NITROGEN, *supra* note 7, at lxxxvii. *See also* Evelyn S. Kimbrough et al., *Seasonal and Diurnal Analysis of NO2 Concentrations From a Long-Duration Study Conducted in Las Vegas, Nevada*, 63 J. AIR & WASTE MGMT. ASS'N 934 (2013) (showing higher concentrations closer to highways).
78. *See, e.g.*, Luther Smith et al., *Near-Road Measurements for Nitrogen Dioxide and its Association with Traffic Exposure Zones*, 6 ATMOSPHERIC POLLUTION RES. 1082 (2015); Shaibal Mukerjee et al., *Comparison of Modeled Traffic Exposure Zones Using On-Road Air Pollution Measurements*, 6 ATMOSPHERIC POLLUTION RES. 82 (2015) (showing highest exposure levels for heavily trafficked areas as opposed to traffic signals and bus routes).
79. Xianglu Han & Luke P. Naeher, *A Review of Traffic-Related Air Pollution Exposure Assessment Studies in the Developing World*, 32 ENV'T INT'L 106, 108 (2006).
80. *See generally* Shih Ying Chang et al., *supra* note 5.
81. Boehmer et al., *supra* note 31, at 46–50.

more than a third of the population lives within 300 meters of a freeway or major road.[82] Of the 11 million Americans living within 150 meters of a major highway, about a quarter are under the age of 18 and just under half are nonwhite.[83] Latinos, African Americans, and Asian/Pacific Islanders are much more likely to live next to a highway than whites.[84] Close to half of near-highway residents are poor or near-poor.[85]

Exposure to higher levels of NO2 and particulate matter is not limited to residents who live near roads. Children riding on diesel school buses face some of the most alarming exposure rates to carcinogenic particulate matter. In a study of Connecticut school buses, researchers found some buses with fine particulate measurements five to fifteen times higher than ambient levels outside.[86] California researchers found similarly alarming levels inside Los Angeles-area buses.[87] Occupants of vehicles in heavily trafficked areas also experience elevated levels of pollutants. Levels of PM can be elevated by as much as 40 percent for PM 10 and by 16 percent to 17 percent for fine particulate matter at trafficked intersections.[88] Use of the ventilation system in a car, however, can reduce exposure significantly.[89]

Mobile sources also play a major role in making ports one of the most significant contributors to air pollution and one of the most polluted microclimates. EPA estimates that about 39 million people live in close proximity to a port and acknowledges that diesel emissions from drayage, longer-trip truck traffic, ocean-going vessels, and so forth produce serious health risks for residents living in close proximity.[90] In Los Angeles, emissions from the Los Angeles and Long Beach ports constitute the single largest air pollution source in the region.[91]

---

82. *See* HEALTH EFFECTS INST., *supra* note 21, at 17.
83. BOEHMER ET AL., *supra* note 31, at 48 tbl.
84. *Id.*
85. *Id.*
86. WARGO, *supra* note 1, at 5.
87. Lisa D. Sabin et al., *Characterizing the Range of Children's Air Pollutant Exposure During School Bus Commutes*, 15 J. EXPOSURE ANALYSIS & ENVTL. EPIDEMIOLOGY 377 (2005).
88. *See* Prashant Kumar & Anju Goel, *Concentration Dynamics of Coarse and Fine Particulate Matter at and Around Signalised Traffic Intersections*, 18 ENVTL. SCI. PROCESSES & IMPACTS 1220, 1234 (2016).
89. *See* N. Hudda & S.A. Fruin, *Models for Predicting the Ratio of Particulate Pollutant Concentrations Inside Vehicles to Roadways*, 47 ENVTL. SCI. & TECH. 11,048, 11,054 (2013).
90. EPA, NATIONAL PORT STRATEGY ASSESSMENT: REDUCING AIR POLLUTION AND GREENHOUSE GASES AT U.S. PORTS 1, https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100PGK9.pdf.
91. *See* S. COAST AIR QUALITY MGMT. DISTRICT, CLEAN PORT, http://www.aqmd.gov/home/about/initiatives/clean-port [https://perma.cc/S3X9-U999] (last visited Dec. 25, 2017).

B. Stationary Sources

There is a surprising dearth of data about near-site exposure to emissions of NAAQS pollutants from stationary sources like power plants, refineries, and chemical plants. Somewhat more data exists for toxic emissions from large stationary sources, but those tend to analyze exposure at the census tract-level, where researchers acknowledge that the size of the census tract is not small enough to provide precise estimates of exposure for those closest to the source.[92]

One major concern about emissions from refineries and chemical plants—which emit some of the most toxic pollutants along with conventional NAAQS pollutants—is that there may be systematic underreporting errors in emissions measurements based on measuring techniques the plants use with approval from EPA. In a recent evaluation of emissions in the Houston Shipping Channel, home to one of the largest concentrations of chemical and petrochemical refineries in the world, researchers used testing devices that measured emissions of VOCs and benzene at levels far higher than the estimates produced and reported by the facilities themselves.[93] VOCs emissions were 41 percent higher than emissions inventories reported, and benzene emissions were 94 percent higher.[94] Preliminary results from real-time monitoring of refineries and other sources in the Los Angeles area show similar outcomes, with VOCs emissions three to twelve times higher than emissions inventories report.[95]

---

92. *See* Adelman, *supra* note 10, at 300 (noting that urban census tracts are on average about two square miles, while rural tracts are much larger). In an extensive analysis of data about toxic releases from stationary sources, culled from EPA data, Adelman concludes that less than 10 percent of toxic air emissions come from large industrial sources, with the exception of Texas, given its high concentration of refineries and chemical facilities. Even in the census tracts packed with large industrial sources, toxic emissions from these facilities comprise just over a quarter of total air toxics emissions and only about 10 percent of the excess cancer risk. *Id.* at 277.

93. Daniel Hoyt & Loren H. Raun, *Measured and Estimated Benzene and Volatile Organic Carbon (VOC) Emissions at a Major U.S. Refinery/Chemical Plant: Comparison and Prioritization*, 65 J AIR & WASTE MGMT. ASS'N 1020, 1021 (2015); see also Cuclis, supra note 8., (Aug. 15, 2012), https://www3.epa.gov/ttnchie1/conference/ei20/session7/acuclis.pdf.

94. Hoyt, *supra* note 93, at 1029.

95. Johan Mellqvist et al., *Quantification of Gas Emissions From Refineries, Gas Stations, Oil Wells and Agriculture Using Optical Solar Occultation Flux and Tracer Correlation Methods*, Presentation for American Geophysical Union Annual Conference Session (Dec. 12, 2016), https://agu.confex.com/agu/fm16/meetingapp.cgi/Paper/180782, *reported in* Emily Guerin, *Refineries in LA Emit Up to 12 Times More Toxic Chemicals*

III. WHY THE NAAQS ARE NOT WELL-DESIGNED TO TACKLE NEAR-SOURCE POLLUTION

A. The Concept of Ambient Air Pollution

The NAAQS system is almost by definition designed not to address near-source pollution. The NAAQS measurements are based on averages, culled from monitoring and models, of the ambient air quality across large geographic areas. They do not, nor are they meant to, measure air quality in small, geographically confined areas.

EPA requires states to monitor background levels of pollution, determine whether those levels are consistent with the NAAQS that has been set, and then issue plans to either stay in attainment with the pollution standard or come into compliance with it.[96] The idea is not to limit any particular individual source to a specific amount of pollution but instead to regulate all sources of a particular NAAQS pollutant within an air basin to a level sufficient to produce attainment with the NAAQS.[97] As a result, EPA requires monitors to be placed in a location that will measure pollutants at an appropriate scale to measure ambient pollution.[98] The number of required monitors provides a good illustration of the ambient nature of the measurements: For metropolitan areas with a population of greater than 10 million, four monitors are required to measure ozone, while three monitors

Than Reported, KPCC (Dec. 29, 2016), http://www.scpr.org/news/2016/12/29/67663/la-area-refineries-emit-up-to-12-times-more-toxic.

96. The monitoring regulations are contained in 40 C.F.R. § 58 (2017). Appendix D provides details about the numbers of monitors required by population for individual pollutants, the types of monitors required, and the ways in which monitoring should proceed. Section 107(a) requires that each state submit "an implementation plan for such State which will specify the manner in which national primary and secondary ambient air quality standards will be achieved and maintained within each air quality control region in such State." 42 U.S.C. § 7407(a) (2012).

97. 42 U.S.C. § 7410(a) requires states to demonstrate how they will either maintain or come into compliance with a NAAQS without requiring any individual source to meet a specified emissions limit. The Prevention of Significant Deterioration provisions require new and modified sources to obtain a permit designed to demonstrate that any emissions from their facilities will not throw the air district in which they are operating out of attainment, rather than to control a set amount of emissions. *See* EPA, PREVENTION OF SIGNIFICANT DETERIORATION BASIC INFORMATION, https://www.epa.gov/nsr/prevention-significant-deterioration-basic-information (last visited Mar. 7, 2018).

98. *See* 40 C.F.R. § 58 app. D (setting forth a number of monitors and placement requirements for various pollutants).

are required to measure PM 2.5 in cities with a population of more than a million.[99]

Although the NAAQS system is designed to measure ambient air in large geographical areas, EPA is not insensitive to the issues posed by microclimate pollution and, as the science has become stronger, has taken several steps to try to address it. But the statutory scheme under which the agency regulates was not designed to simultaneously target ambient air pollution caused by a large number of sources and microclimate pollution that causes near-source harm. Moreover, different NAAQS pollutants pose different measurement and monitoring challenges depending on their primary sources.

B. EPA Measures to Address Near-Source Pollution

Despite the limitations of the NAAQS, EPA has attempted to use three separate regulatory mechanisms in order to address near-source pollution. It has redefined the concept of "ambient" by using different background scales for different pollutants, including a "micro" scale. It has established a new NO2 standard directly addressed to near-source pollution. And it has modified some emissions factors for refineries based on evidence that the factors were underestimating certain pollutant emissions. Beginning in 2018, refineries will be required to monitor certain pollutants at their fence-lines.

1. Definition of Scale for Monitoring Purposes

The first mechanism EPA uses to attempt to address microclimate pollution is to require monitoring based on different scales depending on the NAAQS pollutant being addressed.[100] The monitoring regulations set forth

99. *See* 40 C.F.R. § 58 app. D, tbls. D-1 & D-5.

100. I assume in this paper that air districts place their monitors in a manner that is not only consistent with EPA regulations but that is also designed to measure accurately the ambient pollution levels necessary to establish compliance with the NAAQS. My assumption may be too sanguine. In a forthcoming paper, Corbett Grainger and coauthors evaluate whether air pollution regulators in air districts that are in attainment but only marginally place new monitors designed to measure NO2 and Ozone strategically to avoid kicking their districts into nonattainment. Using remote-sensing and other data to measure actual background levels of the pollutants, Grainger compares the data with collected monitoring data. The authors conclude that these air districts appear to be systematically understating background pollution levels. *See generally* Corbett Grainger, Andrew Schreiber & Wonjun Chaing, *Do Regulators Strategically Avoid Pollution Hot Spots When Siting Monitors? Evidence from Remote Sensing of Monitors* (Oct. 2017) (draft on file with author).

different spatial scales that are designed to be used with different pollutants. There are six scales ranging from smallest (microscale) to largest (national and global scales).[101] The regulations explain that "[p]roper siting of a monitor requires specification of the monitoring objective, the types of sites necessary to meet the objective, and then the desired spatial scale of representativeness."[102] States should use neighborhood, urban, and regional spatial scales to measure ozone, for example, given that it is a secondary pollutant that does not cause near-exposure problems.[103] In recognition of the health consequences of NO2, by contrast, EPA now requires the placement of one microscale monitoring station near roads in metropolitan areas with a population of greater than 1 million and two for populations greater than 2.5 million.[104] NO2 monitoring is not only done at the microscale level, however, but also requires monitoring at the middle and neighborhood scales.[105]

The choice of the appropriate scale for monitoring PM 2.5 is more complex and also demonstrates one of the reasons why the NAAQS system presents an awkward fit to address microclimate pollution.[106] While it is true that near-road exposure to PM 2.5 causes many health problems, PM 2.5 exposure is also a regional pollutant and shows less spatial variability than a pollutant like NO2.[107] The composition of PM 2.5 can vary dramatically

101. 40 C.F.R. § 58 app. D at § 1.2.
102. *Id.* § 1.2(c).
103. *Id.* § 4.1(c).
104. *Id.* § 4.3.2(a). Microscale monitoring is also required for carbon monoxide and sulfur dioxide to accompany the NO2 microscale monitoring. *See* 40 C.F.R. § 58 app. D at §§ 4.4.4(a), 4.2.3(a).
105. *Id.* § 4.3.4(a).
106. Interestingly, lead is the one NAAQS pollutant that may be an exception to my argument that the CAA is an awkward fit for microclimate pollution. Since leaded gasoline was phased out, almost all airborne lead has been eliminated. Some stationary sources that emit lead remain, and they are subject to microclimate monitoring. Very few air districts are out of attainment with the 2008 NAAQS for lead. Those out of attainment have, for the most part, distinct stationary sources of lead that create the nonattainment problem and that, if regulated stringently enough, will bring the district into attainment. *See, e.g.*, Cal. Air Res. Bd., *Proposed State Implementation Plan Revision for the Federal Lead Standard 1–2, 5* (May 11, 2012), https://arb.ca.gov/planning/sip/planarea/scabpbstaffrepfinal.pdf (describing the two battery recycling facilities that occasionally cause Los Angeles County to violate the lead NAAQS and describing measures to eliminate violations). The facilities are also required to engage in enhanced source monitoring. *Id.* at 6. The NAAQS system works well for lead because there are so few sources of lead, such that monitoring and regulation can target them.
107. *See, e.g.*, Kathie L. Dionisio et al., *Development and Evaluation of Alternative Approaches for Exposure Assessment of Multiple Air Pollutants in Atlanta, Georgia*, 23 J. EXPOSURE

depending on its sources, with particulate matter from traffic sources comprised of different pollutants than particulate matter from stationary sources.[108] As a result, research has demonstrated that PM 2.5 composition varies significantly across the country: Boston, for example, has significantly higher elemental carbon and NO2 in its PM 2.5 than Pittsburgh, while Pittsburgh has significantly higher concentrations of carbon monoxide and sulfur dioxide.[109] Cities and regions of the country also exhibit different risk levels for mortality from PM 2.5 exposure; yet a recent analysis that attempted to determine the causes of this difference, as well as the sources of PM 2.5 pollution, concluded that "[w]hile it is clear that each city is impacted by different air pollution source mixtures, it is unclear which sources contribute to the differences in risk estimates between the cities."[110]

As a result of the regional nature of PM 2.5 and its different sources, the choice of what scale to monitor is less obvious than that for NO2, which is more uniformly a traffic-related pollutant. EPA therefore recommends monitoring at the neighborhood scale for PM 2.5, though large cities are required to include with their microscale NO2 monitor a PM 2.5 monitor.[111] EPA also makes clear that microscale or middle-scale monitoring may be appropriate if it is "considered to represent area-wide air quality."[112]

Indeed, EPA has opposed efforts to require air districts to measure and monitor near-source/microclimate pollution for purposes of compliance with the NAAQS. Environmental groups in Southern California recently challenged the South Coast Air Quality Management District's monitoring plan that EPA had approved for PM 2.5. The plaintiffs argued that the plan should be invalidated for failing to include a near-road monitor. EPA explained its opposition to the plaintiffs' argument:

SCI. & ENVTL. EPIDEMIOLOGY 581 (2013) (showing less spatial variability across Atlanta for PM 2.5 than for NOx and other traffic-related pollutants).

108. *See* PM 2.5 ISA (2009) at 2–7.

109. *See generally* Lisa K. Baxter et al., *Examining the Effects of Air Pollution Composition on Within Region Differences in PM(2.5) Mortality Risk Estimates*, 23 J. EXPOSURE SCI. & ENVTL. EPIDEMIOLOGY, 457 (2013).

110. *Id.* at 463.

111. 40 C.F.R. pt. 58, app. D, 4.6(b), 4.7.1(b)(2) (2017).

112. 40 C.F.R. pt. 58, app. D, § 4.71(b) (2017). The monitoring of SO2 raises similar issues. As the 2008 Integrated Science Assessment for SO2 explains:

> If a monitoring site is to be used to determine air quality over a much larger area, such as a neighborhood or city, a monitoring agency should avoid placing a monitor probe, path or inlet near local, minor sources. The plume from the local minor sources should not be allowed to inappropriately influence the air quality data collected.

INTEGRATED SCIENCE ASSESSMENT FOR SULFUR OXIDES, *supra* note 46, at 2-7 to 2-8.

> As a practical matter, the area of maximum concentration will most often be a very small area in the immediate vicinity of a dominating local source. However, if the monitor is intended to "represent conditions throughout some reasonably homogeneous urban sub-region with dimensions of a few kilometers" as Sections 4.7.1(b) and (c)(3) require, then the location of maximum concentration will usually be elsewhere. If every monitor simply had to be sited at the location where the single highest reading in the Air District was expected, then the concept of Spatial Scale—and the information it conveys as to the risk to people throughout the urban area—would be lost.[113]

In other words, the highest maximum concentrations may well be close to the heaviest traffic route but measuring those concentrations would not provide the requisite representativeness of ambient air. Because EPA and the environmental groups settled the case, it is unclear whether EPA's position is correct as a legal matter; however, it is nevertheless helpful for understanding EPA's attempt to balance highly localized impacts with background air quality.

EPA's concerns about scale of monitoring may also reflect serious concerns about what monitoring at the microscale would do to the attainment status of many states and air districts. Moreover, such monitoring as a means for measuring NAAQS compliance would raise serious concerns about the regulatory consequences of a nonattainment designation that could result from near-road measurements. I explore those consequences in Part IV, *infra*. I first turn, however, to the second regulatory requirement EPA has utilized in recognition of near-road pollution, a new standard for NO2.

2. NO2 One-Hour Standard

In 2010, EPA set a new one-hour standard for NO2 directly in response to evidence that NO2 levels are elevated near heavily trafficked roads and highways. As the preamble to the new standard explains:

> [E]stimates . . . suggest that on/near roadway NO2 concentrations could be approximately 80% higher on average across locations than concentrations away from roadways . . . . Because monitors in the current network are not sited to measure

113. Brief for Respondent at 31–32, Physicians for Soc. Responsibility v. EPA, No. 12-70016 (9th Cir. filed Oct. 2, 2012) (on file with author).

> peak roadway-associated NO2 concentrations, individuals who spend time on and/or near major roadways could experience NO2 concentrations that are considerably higher than indicated by monitors in the current area-wide NO2 monitoring network.[114]

The short-term standard is combined with new monitoring requirements for near-road pollution and is meant to recognize the problems of short-term exposure to elevated levels of NO2 pollution and to get nonattainment states to address roadway pollution.[115] We do not at this point know whether the new short-term standard will lead to nonattainment status for many air regions; because states are only beginning to implement the new standard and the supporting monitoring network, EPA has yet to designate attainment/nonattainment standards for it.[116] If the new standard leads to a significant number of nonattainment designations, states will face a real conundrum about how to respond. This conundrum, raised not just by the new NO2 standard but by any attempt to regulate microclimate pollution caused by traffic, is one of several conundrums the NAAQS provisions of the CAA create for the regulation of microclimate pollution more generally. I address these issues in Part IV, *infra*. In the next Section, however, I explore a third way in which EPA is attempting to address near-source pollution.

3. Improvements in Stationary Source Monitoring

In response to concerns that refineries have been using emissions factors that consistently underestimate actual emissions, EPA has begun to refine emissions calculations for flaring and some other activities from refineries.[117] And beginning in 2018, for the first time refineries will be required to monitor fence-line emissions.[118] This is a major advancement in understanding with precision the actual emissions coming from refineries.

---

114. 75 Fed. Reg. 6471, 6479 (Feb. 9, 2010) (to be codified at 40 C.F.R. pts. 50 & 58).
115. *See supra* notes 104–105 and accompanying text (describing near-road monitoring requirements for the NO2 standard).
116. *See, e.g.*, Letter from Jared Blumenfeld, EPA Region 9 Administrator, to Edmund G. Brown, California Governor (June 29, 2011) (describing EPA decision to designate all areas of the country "unclassifiable" while new monitoring network is implemented).
117. *See* EPA, NEW AND REVISED EMISSION FACTORS FOR FLARES AND NEW EMISSIONS FACTORS FOR CERTAIN REFINERY PROCESS UNITS AND DETERMINATION FOR NO CHANGES TO VOC EMISSION FACTORS FOR TANKS AND WASTEWATER TREATMENT SYSTEMS [hereinafter NEW EMISSIONS FACTORS], https://www3.epa.gov/ttn/chief/consentdecree/index_consent_decree.html [https://perma.cc/NX7H-ZST6].
118. *See* EPA, FACT SHEET: FINAL PETROLEUM REFINERY SECTOR RISK AND TECHNOLOGY REVIEW AND NEW SOURCE PERFORMANCE STANDARDS, https://www.epa.gov/sites/production/

Since EPA began requiring the monitoring of emissions, regulators have relied extensively on emissions factors. These factors are developed by EPA as an inexpensive means to represent actual emissions, but they are based on averages of available data rather than actual monitoring.[119] EPA and states rely heavily on emissions factors in constructing emissions inventories, making permitting, compliance, and enforcement decisions, and developing emissions reductions strategies.[120] And yet a troubling 2006 U.S. EPA Office of Inspector General (OIG) Report evaluating EPA's use of emissions factors concluded that 62 percent of EPA's emissions factors were of below average or poor quality.[121] To be sure, a number of large industrial facilities do actual monitoring, typically for equipment or facilities, for which a permit is required.[122] Nevertheless, the OIG report estimates that EPA relies on emissions factors for 80 percent of its emissions determinations.[123]

EPA has sometimes taken enforcement actions against facilities whose actual emissions significantly exceed reported emissions based on emissions factors. The OIG report recounts enforcement efforts after the issuance of a critical 1996 OIG report against some refineries, wood products manufacturers, and ethanol producers.[124] More recently, the agency—in response to litigation filed by Texas- and Louisiana-based environmental justice groups concerned that emissions data for refineries was inaccurate—evaluated and revised upward VOCs emissions factors for flaring at refineries and several other refinery operations.[125] And finally, after many years of

files/2016-06/documents/2010-0682_factsheet_overview.pdf [https://perma.cc/B8N9-ELQX]. As with many EPA reforms, this change is the result of a citizen suit. For the final rule itself, see Petroleum Refinery Sector Risk and Technology Review and New Source Performance Standards, 80 Fed. Red. 75,178, 75,178–354 (Dec. 1, 2015) (to be codified at 40 C.F.R. §§ 60–63), *available at* https://www.gpo.gov/fdsys/pkg/FR-2015-12-01/pdf/2015-26486.pdf.

119. *See* EPA, AIR EMISSIONS FACTORS AND QUANTIFICATION, BASIC INFORMATION OF AIR EMISSIONS FACTORS AND QUANTIFICATION, https://www.epa.gov/air-emissions-factors-and-quantification/basic-information-air-emissions-factors-and-quantification [https://perma.cc/4YGW-LPX2].

120. *See* EPA, OFFICE OF INSPECTOR GENERAL, EPA CAN IMPROVE EMISSIONS FACTOR DEVELOPMENT AND MANAGEMENT 1, 4–5 (Rep. No. 2006-00017, 2006).

121. *See id.* at 9.

122. *See, e.g.*, 40 C.F.R. §§ 64.1–64.2 (2017) (specifying circumstances under which compliance assurance monitoring is required).

123. EPA, OFFICE OF INSPECTOR GENERAL, *supra* note 120, at 4.

124. *See id.* at 11–13.

125. EPA entered into a consent decree to evaluate emissions factors in *Air Alliance Houston, Community In-Power and Development Association, Inc., Louisiana Bucket Brigade and Texas Environmental Justice Advocacy Services* ("Plaintiffs"). Air Alliance Houston v. Gina McCarthy, No. 1:13-cv-00621-KBJ (D.D.C. filed May 07, 2014). *See* NEW EMISSIONS FACTORS, *supra* note 117.

environmental justice calls for more effective monitoring of refineries, EPA issued a rule in 2016 that will require monitoring at the fence-lines of refineries to determine actual exposure levels beginning in 2018.

The use of emissions factors to estimate emissions from stationary sources makes sense for measuring ambient pollution at a relatively large scale, even if the emissions factors are not completely accurate. If near-source pollution exposure is not a significant health issue, then, as long as ambient concentrations are measured effectively and are within NAAQS limits, the absolute contribution of any individual source is not as important as the cumulative contributions of all the sources in an air basin. But as our scientific understanding about near-source exposure to pollutants like PM 2.5 and NOx has improved, the importance of the accuracy of individual source emissions has increased. Yet our measuring and monitoring of stationary source emissions appear not to have kept up, with the exception of the new refinery monitoring requirements. Nor is the ambient focus of the CAA particularly well-suited to address individual stationary source emissions in order to address near-source exposure.

I turn to the structural problems NAAQS regulations raise for hotspot pollution next.

IV. Unsuitability of NAAQS Regulation for Targeting Hotspot Pollution

A. State v. Federal Authority Over Sources and the Problem of Near-Road Exposure

The division of CAA authority between states and the federal government for the regulation of different types of sources poses perhaps the biggest structural barrier to the regulation of near-road pollution. The familiar cooperative federalism structure of the CAA is worth describing here in order to explain this barrier.

Once a state is designated as either in or out of attainment with a particular ambient air standard, it must prepare a state implementation plan (SIP) that demonstrates either how the area will maintain its air quality in order to remain in attainment with the NAAQS or how the area will come into attainment.[126] States must submit their SIPs to EPA for approval. Every five years, the CAA requires EPA to review the criteria on which a NAAQS is

126. 42 U.S.C. § 7410(a)(1) (2012).

based and update the standards consistent with the new information.[127] If a standard is tightened, a new series of attainment/nonattainment designations and SIP updating must occur.[128]

The SIP process is designed to allow states discretion to develop their own regulatory regimes that will either maintain or achieve compliance with the NAAQS. Nevertheless, state discretion is limited in important ways. Most significantly, states have very little power to directly regulate emissions from mobile sources and substantially more control over the regulation of stationary sources, though even that discretion is cabined in important ways.[129] Relatively speaking, however, if a state is out of attainment with the NAAQS, it has more power to regulate and tighten up on stationary sources than it does mobile sources.

The establishment of the one-hour NO2 NAAQS brings this distinction between stationary source and mobile source regulatory authority into stark relief: If a state is found to be in nonattainment with the one-hour standard, its options for directly regulating mobile sources are limited. The same would be true if states were required to monitor PM 2.5 at near-road sites, if the monitors produced readings that kicked a state or one of its air districts into nonattainment or a more serious designation.

To be sure, not all options are foreclosed to states. One way to think about how to reduce near-road emissions is to think broadly about ways to reduce human exposure. States could reduce the emissions that are coming out of mobile sources; they could try to channel the emissions away from humans; or they could keep the humans away from the emissions. Below I explore the role of the CAA in reducing mobile source emissions.

B. Directly Reducing Emissions From Mobile Sources

1. Tailpipe Emissions From New Mobile Sources

Mobile source emissions are the cause of most near-road emissions, comprise 60 percent of NO2 emissions, and make up a large share of PM 2.5. Diesel emissions from heavy trucks and other diesel engines are of particular concern, with some studies showing that half of near-road particulate matter

127. 42 U.S.C. § 7409(d)(1) (2012).
128. 42 U.S.C. § 7410(a)(2)(H)(i) (2012).
129. Requirements for technology-based standards for ozone attainment zones are one example of this, as the stringency of the requirement ratchets up the further an air district is out of attainment with the NAAQS.

comes from heavy-duty diesel engines.[130] In the long term, the most direct way of cleaning up these emissions is to prevent them from coming out of tailpipes in the first place.

To be sure, federal and California regulations have been remarkably successful in reducing tailpipe emissions for new passenger automobiles, achieving reductions by as much as 99 percent compared with cars manufactured in the 1960s.[131] EPA has also issued a series of regulations over the years to clean up heavy-duty diesel engines and to require the use of low-sulfur diesel fuel. The most significant of these regulations required new standards for model year engines 2004 and later and standards mandating engine modifications to allow for the use of low-sulfur diesel fuel.[132] EPA has also recently paired with the National Highway Transportation and Safety Administration to tighten fuel economy standards for passenger, medium, and heavy duty vehicles, which I explore in more detail in Part V, *infra.*

Nevertheless, even with stringent emissions standards, as I have already detailed, mobile sources continue to emit huge percentages of many NAAQs pollutants (as much as 60 percent of NO2 pollution and more than a quarter of PM 2.5) and continue to cause near-road exposure problems. As a result, a state facing nonattainment for the new NO2 short-term exposure standard,

130. Shih Ying Chang et al., *supra* note 5, at 916.

131. *See* EPA, *History of Reducing Air Pollution From Transportation in the United States*, https://www.epa.gov/air-pollution-transportation/accomplishments-and-success-air-pollution-transportation (last visited March 26, 2018).

132. *See* EPA, REGULATIONS FOR EMISSIONS FROM VEHICLES AND ENGINES, FINAL RULE FOR CONTROL OF EMISSIONS OF AIR POLLUTION FROM HIGHWAY HEAVY-DUTY ENGINES [hereinafter REGULATIONS FOR EMISSIONS FROM VEHICLES AND ENGINES],https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-control-emissions-air-pollution-highway-heavy [https://perma.cc/Q8DG-CZDZ]; 40 C.F.R. pts. 9, 86 (2016); EPA, REGULATIONS FOR EMISSIONS FROM VEHICLES AND ENGINES, FINAL RULE FOR CONTROL OF EMISSIONS OF AIR POLLUTION FROM 2004 AND LATER MODEL YEAR HEAVY-DUTY HIGHWAY ENGINES AND VEHICLES [hereinafter LATER MODEL YEAR HEAVY-DUTY HIGHWAY ENGINES AND VEHICLES], https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-control-emissions-air-pollution-2004-and-later [https://perma.cc/8K76-3AVT]; EPA, REVISION OF LIGHT-DUTY ON-BOARD DIAGNOSTICS REQUIREMENTS [hereinafter LIGHT-DUTY ON-BOARD DIAGNOSTICS REQUIREMENTS], https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-control-emissions-air-pollution-2004-and-later [https://perma.cc/8K76-3AVT]; EPA, REGULATORY ANNOUNCEMENT, FINAL EMISSION STANDARDS FOR 2004 AND LATER MODEL YEAR HIGHWAY HEAVY-DUTY VEHICLES AND ENGINES (July 2000) [hereinafter FINAL EMISSION STANDARDS FOR 2004 AND LATER MODEL], https://nepis.epa.gov/Exe/ZyPDF.cgi/P1001YS2.PDF?Dockey=P1001YS2.PDF [https://perma.cc/9DP4-2DG4]; EPA, HEAVY-DUTY ENGINE AND VEHICLE STANDARDS AND HIGHWAY DIESEL FUEL SULFUR CONTROL REQUIREMENTS (Dec. 2000) [hereinafter HEAVY-DUTY ENGINE AND VEHICLE STANDARDS AND HIGHWAY DIESEL], https://nepis.epa.gov/Exe/ZyPDF.cgi/P1001CXZ.PDF?Dockey=P1001CXZ.PDF [https://perma.cc/2R9P-85GG].

or a state forced to use near-road monitoring to demonstrate PM 2.5 attainment status for the twenty-four-hour standard, would most likely want to rely on more stringent tailpipe emissions in its SIP to demonstrate how it would come into attainment.

The problem with a strategy that relies on regulating tailpipe emissions, however, is that states have very little authority to do so. Section 209 of the CAA preempts all states from regulating emissions from mobile sources, with the exception of California, which can set standards so long as they are at least as protective of public health and welfare as the federal standards.[133] States may choose to follow either the federal standards or the California standards, but may not impose their own.[134] States are also prohibited from regulating emissions from nonroad vehicles, again with the exception of California, with a similar option to choose to follow the federal standards or the California standards.[135] As a result, a state or air district seeking to reduce near-road emissions can either follow the federal standards or California standards but cannot regulate any class of motor vehicles more stringently than those two standards in an attempt to come into attainment. A state's SIP for nonattainment for near-road sources, then, could not easily rely on the most direct mechanism for addressing the problem. At best, a state that does not already follow the California standards could choose to do so.

Even following California standards does little, however, to address heavy-duty vehicle emissions. Because trucks often enter a state from other states in order to transport cargo, in-state heavy-duty regulation is likely to be insufficient to solve the problem. Even California, which has its own authority to regulate heavy-duty emissions and an economy far larger than most states, faces this problem. Two of California's air districts, along with a number of air districts from across the country, recently petitioned EPA to regulate NOx emissions from heavy-duty engines more stringently in order to assist them in coming into attainment with the new ozone and PM standards.[136] As EPA noted in its response, between 40 and 67 percent of NOx emissions across the country come from mobile sources. In Southern California, this number rises to 88 percent, with the largest source category

133. 42 U.S.C. § 7543 (a)–(b) (2012).
134. *Id.* § 7507.
135. *Id.* § 7543(e).
136. *See* EPA, MEMORANDUM IN RESPONSE TO PETITION FOR RULEMAKING TO ADOPT ULTRA-LOW NO(X) STANDARDS FOR ON-HIGHWAY HEAVY-DUTY TRUCKS AND ENGINES 5 (2016) [hereinafter MEMORANDUM IN RESPONSE TO PETITION], https://www.epa.gov/sites/production/files/2016-12/documents/nox-memorandum-nox-petition-response-2016-12-20.pdf [https://perma.cc/AEV9-9JC8].

being diesel trucks.[137] Without federal regulatory action, many districts will not be able to comply with new standards for ozone and PM.[138] This problem is even more acute for near-road exposure, which is entirely caused by mobile sources, with heavy-duty trucks playing a key role.

2. Regulation of Fuels

Unlike tailpipe emissions, states do have authority to regulate fuels with permission from EPA, subject to some significant limitations, and could attempt to do so to reduce near-road exposure. State authority here, however, is limited in important ways. Under the 1990 Amendments to the CAA, states gained authority to require the use of new fuels under certain conditions with EPA approval. EPA could approve a state fuel requirement, but only if it found that the regulation of fuel is necessary to achieve the NAAQS and that "no other measures . . . would bring about timely attainment . . . ," unless the state could show that other measures "are technically possible to implement, but are unreasonable or impracticable."[139] This authority led EPA to approve seven different fuels used in twelve different states around the country.[140] The proliferation of these so-called "boutique" fuels led to opposition from industry groups and Congress responded in the Energy Policy Act of 2005. The Act restricted state authority by allowing the use of only those seven fuels already approved by EPA as of the time of the amendments.[141] Thus, states can require less polluting fuels, but can only use those already on the boutique fuels list and only with EPA approval.

California, once again, has its own authority to regulate fuels, but unlike the mobile source emissions authority, other states cannot adopt California fuels absent a showing to EPA that adoption of California fuel is necessary for NAAQS attainment.[142] Moreover, for diesel fuel, some of the same interstate

137. *See id.* at 5.
138. Although EPA indicated in its responsive memorandum to the air district petition that it would initiate rule-making proceedings, *see id.* at 20, given the change in EPA leadership such a regulatory move now seems unlikely.
139. 42 U.S.C. § 7545(c)(4)(C).
140. *See* EPA, GASOLINE STANDARDS, STATE FUELS, https://www.epa.gov/gasoline-standards/state-fuels (last visited Mar. 7, 2018) (listing approved fuels).
141. Energy Policy Act of 2005, Pub. L. No. 109-58, § 1541(b), 119 Stat. 1107 (2005).
142. *See* Motor Vehicle Mfrs. Ass'n v. N.Y. State Dep't of Envt'l Conservation, 810 F. Supp. 1331, 1343 (N.D.N.Y. 1993) *modified*, 831 F. Supp. 57 (N.D.N.Y. 1993) *aff'd in part, rev'd in part*, 17 F.3d 521 (2d Cir. 1994) (describing approval requirements).

issues that arise with the regulation of heavy-duty truck emissions also arise with fuels, with cross-border trucks creating significant emissions.

C. Existing v. New Mobile Sources

Just as the CAA requires much more stringent regulation of new stationary sources as opposed to existing ones, it has also long focused much more attention on new vehicles than existing ones. Yet older vehicles of all categories are significantly dirtier than new ones and are the major cause of near-road pollution. A recent and sophisticated study of passenger vehicle emissions showed that 90 percent of NOx emissions came from just 25 percent of automobiles and the top 5 percent of emitters contributed 40 percent of carbon monoxide and black carbon.[143] California estimates that 70 percent of air toxics come from diesel engines.[144]

The CAA does require some states to address pollution from older passenger vehicles in relatively limited ways. In recognition of the contribution of existing mobile sources to ambient air pollution, the 1990 CAA amendments required ozone and carbon monoxide nonattainment areas to establish inspection and maintenance programs for existing vehicles.[145] The programs have until very recently been rife with fraud and largely ineffectual, and they also raise complex distributional questions about how to pay for repairs and upgrades to older cars.[146] And they have been aimed at nonattainment areas rather than near-road exposure.

EPA has done even less to address the largest existing mobile source problem: emissions from heavy-duty vehicles. In 1993, EPA required large cities (greater than 750,000 in population) to retrofit older urban buses, if they were

143. *See* J. M. Wang et al., *Plume-Based Analysis of Vehicle Fleet Air Pollutant Emissions and the Contributions From High Emitters*, 8 ATMOSPHERIC MEASUREMENT TECH. 3263, [3271] (2015) (studying vehicular emissions in Ontario, Canada). Canadian emissions regulations follow U.S. 2007 Tier 2 standards. *See id.* at [3271].

144. Cal. Air Res. Bd., *Overview: Diesel Exhaust and Health*, https://www.arb.ca.gov/research/diesel/diesel-health.htm (last visited March 26, 2018).

145. *See, e.g.*, 42 U.S.C. § 7511a(a)(2)(B) (2012) (requiring inspection and maintenance programs for marginal ozone non-attainment zones).

146. *See* Amihai Glazer et al., *Clean on Paper, Dirty on the Road: Troubles With California's Smog Check*, 29 J. TRANSPORT ECON. & POL'Y 85, 85–86 (1995) (showing large discrepancies between inspection failure rates in Inspection & Maintenance facilities compared with failure rates in roadside audits, lower emissions reductions than predicted, fraud in testing facilities).

being replaced or rebuilt.[147] EPA also has a number of voluntary incentive programs to retrofit heavy-duty diesel engines and, since 2005 with the adoption of the Diesel Emission Reduction Act, has provided some funding for states to retrofit old engines in school buses and other heavy duty vehicles.[148] The Trump Administration has, however, proposed reducing this funding by 83 percent in the 2017–2018 budget.[149] The result is that long-lived heavy-duty engines remain on the road for decades.[150] Moreover, EPA recently proposed rolling back emissions standards for "glider kits," (which is essentially a new chassis with an old engine) even though evidence shows that they emit vastly more particulate matter and NOx than new engines.[151]

D. Issues With Stationary Sources and Their Relationship to Mobile Sources

The regulation of stationary sources under the CAA raises its own issues in how states can address near-road exposure. The first, the application of New Source Review, has already arisen with respect to the NO2 short-term standard. The second, the propensity to regulate stationary sources in response to a problem caused largely by mobile sources, could occur with efforts either to implement the NO2 standard or in response to monitoring of PM 2.5 at roadside. This propensity is even more problematic because of the distinction the CAA makes between new and existing sources. Finally, the likelihood that stationary source-targeting will occur is compounded by the Clean Air Act's requirement that SIPs contain enforceable emissions limitations requirements.

147. *See* 40 C.F.R. § 85.1401 (2016); *United States: Urban Bus Retrofit Rebuild (UBRR) Program*, DIESELNET, https://www.dieselnet.com/standards/us/ubrr.php (last visited Mar. 7, 2018) (describing program).

148. *See* EPA, CLEAN DIESEL AND DERA FUNDING, https://www.epa.gov/cleandiesel [https://perma.cc/3F4E-VNK8] (last visited Mar. 7, 2018) (describing programs and funding levels).

149. *See* Lauren Tyler, *Trump's Proposed Budget Cuts Funding Available for Clean Transportation*, NGT NEWS (May 23, 2017), https://ngtnews.com/trumps-proposed-budget-cuts-funding-available-for-clean-transportation [https://perma.cc/TTN4-KC39].

150. *See* CAL. ENVTL. PROT. AGENCY AIR RES. BD., DRAFT, SUPPORTING INFORMATION FOR TECHNOLOGY ASSESSMENTS: TRUCK AND BUS SECTOR DESCRIPTION, at VI-2 (2016) (describing shelf-life and durability of heavy duty engines).

151. EPA, PROPOSED RULE FOR REPEAL OF EMISSIONS REQUIREMENTS FOR GLIDER VEHICLES, GLIDER ENGINES AND GLIDER KITS; *see also*, *Heavy-Duty Truck "Glider Kit" Rule*, ENVTL. L. HARV., http://environment.law.harvard.edu/2018/02/heavy-duty-truck-glider-kit-rule/ [https://perma.cc/2PN9-BUWD](last visited March 28, 2018).

Before detailing problems with stationary source regulation and microclimate pollution, it is worth noting that EPA has made significant strides in reducing pollutants from these sources, including from existing, rather than stationary, sources. Three programs are particularly noteworthy. The first, the Acid Rain Trading Program, targeted the electric power sector through the country's first large-scale cap-and-trade program. It cut sulfur dioxide from power plants by 50 percent compared to 1980 levels and led to a significant decline in NOx pollution.[152] The second, a series of cap-and-trade programs EPA established to tackle cross-state ozone pollution, have significantly reduced NOx and sulfur dioxide as well.[153] Importantly, these reductions have also led to significant reductions in particulate matter.[154] And finally, a recently adopted rule aimed at toxic pollutants emitted from the power sector, known as the MATS rule,[155] will result in major reductions not only in toxic pollutants like mercury but in particulate matter as well. In fact, the vast majority of the health benefits that will result from the MATS rule will come from reductions in fine particulates, including NO2 and sulfur dioxide particles.[156]

Despite these successful regulatory efforts, problems remain with stationary sources and near-source exposure. The first issue has already arisen with the regulation of NO2 and the new near-road standard. The CAA requires any new or modified stationary source to obtain a permit before beginning operation, whether in an attainment or nonattainment area, if the source will emit a specified number of tons per year of a regulated pollutant.[157] Although

152. *See* U.S. EPA, CLEAN AIR MARKETS, ACID RAIN PROGRAM, https://www.epa.gov/airmarkets/acid-rain-program [https://perma.cc/VVK9-654V] (describing pollution reductions).
153. *See* U.S. EPA, CLEAN AIR MARKETS, INTERSTATE AIR POLLUTION TRANSPORT, https://www.epa.gov/airmarkets/interstate-air-pollution-transport [https://perma.cc/J5WR-L5E7] (describing and linking to programs).
154. *See id.*
155. 40 C.F.R. pt. 63 (2017). The MATS rule was successfully challenged on the grounds that EPA issued it without considering the costs of the rule in *Michigan v. EPA*, 135 S. Ct. 2699 (2015). EPA subsequently reconsidered the rule in light of the Court's decision and found that cost considerations did not change its determination that the rule is appropriate. 81 Fed. Reg. 24,420 (April 25, 2016). The rule is now being put into effect.
156. *See* U.S. EPA, REGULATORY IMPACT ANALYSIS FOR THE FINAL MERCURY AND AIR TOXICS STANDARDS, at ES-1 (Dec. 2011), https://www3.epa.gov/ttnecas1/regdata/RIAs/matsriafinal.pdf (outlining massive co-benefits from reduction of PM 2.5).
157. For an explanation of these New Source Review requirements, see U.S. EPA, NEW SOURCE REVIEW (NSR) PERMITTING, LEARN ABOUT NEW SOURCE REVIEW, https://www.epa.gov/nsr/learn-about-new-source-review [https://perma.cc/ET5D-9HDT]. The PSD (attainment) provisions are contained in 42 U.S.C. §§ 7475(a). The provisions for new sources in non-attainment areas are contained in 42 U.S.C. § 7503 (2012).

the NO2 one-hour standard was explicitly motivated by the health problems associated with exposure to near-road pollution, EPA issued a guidance memorandum shortly after the standard was adopted, making clear (appropriately given the statutory requirements) that the stationary source permitting provisions were triggered by the new standard.[158]

Shortly after the issuance of the initial guidance memorandum, it became clear that a relatively large number of new and modified stationary sources were having trouble getting permitted. These sources apparently found, based on modeling, that they would be in violation of the standard.[159] The sources included emergency electric generating units, pump stations, power plants, paper mills, and refineries.[160] In order to reduce the number of stationary sources having difficulty getting permits given the modeling results, EPA has issued a series of guidance memoranda to "facilitate the permitting of new and modified PSD [Prevention of Significant Deterioration] major stationary sources."[161] Presumably, even with this guidance, seemingly designed to demonstrate that the sources will not need permits, some sources will continue to violate the standard and will need to install the "best available control technology" (BACT) as a result.[162]

There are at least two problems with the fact that new and modified stationary sources may be required to get permits and install BACT technology as a result of the new one-hour NO2 standard. First, the new standard was motivated by near-road pollution, not by stationary source emissions. Thus, requiring permits of new and modified stationary sources will do nothing to solve the problem, nor will it help bring air districts that are out of compliance because of near-road exposure into attainment with the one-hour standard. Moreover, to the degree that stationary sources are causing near-source exposure problems, exposure levels are likely to be far worse at existing stationary sources, like refineries and power plants. Yet existing sources are

158. *See* U.S. EPA, MEMORANDUM, APPLICABILITY OF THE FEDERAL PREVENTION OF SIGNIFICANT DETERIORATION PERMIT REQUIREMENTS TO NEW AND REVISED NATIONAL AMBIENT AIR QUALITY STANDARDS 1 (Apr. 1, 2010), https://www.epa.gov/sites/production/files/2015-07/documents/psdnaaqs.pdf.
159. U.S. EPA, MEMORANDUM, GUIDANCE CONCERNING THE IMPLEMENTATION OF THE 1-HOUR NO(2) NAAQS FOR THE PREVENTION OF SIGNIFICANT DETERIORATION PROGRAM 1 (June 29, 2010), https://www3.epa.gov/ttn/naaqs/aqmguide/collection/nsr/appwno2.pdf.
160. *See id.*
161. U.S. EPA, ADDITIONAL CLARIFICATION REGARDING APPLICATION OF APPENDIX W MODELING GUIDANCE FOR THE 1-HOUR NO(2) NATIONAL AMBIENT AIR QUALITY STANDARD (Mar. 1, 2011), https://www.epa.gov/sites/production/files/2015-07/documents/appwno2_2.pdf.
162. 42 U.S.C. § 7475(a)(4) (2012).

largely exempt from NAAQS regulation under the CAA, unless they are modified in a manner that triggers New Source Review[163] or unless they are in nonattainment areas.[164] The existing/new source division and problem are hardly unique to the one-hour NO2 standard. However, it is worth pointing out that if the aim of the new standard is to reduce near-term exposure to pollutants at dangerous levels, targeting new stationary sources, as the CAA does, is not likely to solve the problem.[165]

The second problem with the structure of the CAA for regulating near-source pollution is that, if states are found to be out of attainment or if near-road monitors are used to measure PM 2.5 and kick a district out of attainment or further out of attainment, then the CAA pushes states to clamp down further on stationary as opposed to mobile sources. This structural incentive exists, again, because states have much less power over mobile source emissions than they do over stationary sources, even when the pollution problem is caused by mobile source emissions. States must impose "reasonably available control measures" on existing sources in the area if out of attainment with a NAAQS.[166]

Finally, the SIP provisions of the CAA contain a strong directive to states to include "enforceable emission limitations" and other direct control measures to demonstrate maintenance or attainment with an air standard.[167] As a result, states are likely to look to stationary sources, on which they can impose enforceable emissions limits, to reduce NO2 or PM 2.5 emissions.

1. Stationary Sources, Emissions Factors, and Near-Source Exposure

As I described above, EPA and states rely extensively on emissions factors for stationary sources to estimate emissions. For ambient concentrations of pollutants that do not create near-source problems (SO2 is an example),[168] emissions factors work reasonably well as long as background monitoring is accurate and effective. For a pollutant like PM 2.5, however, with known near-

163. See 42 § 7479(1) (2012) for a definition of new source.
164. *See* 42 U.S.C. § 7502(c)(1) (2012) (requiring "reasonably available control measures," including "from existing sources").
165. *See, e.g.*, Dialogue, *Grandfathering Coal: Power Plant Regulation Under the Clean Air Act*, 46 ENVTL. L. REP. 10541, 10542 (2016) (discussion of RICHARD REVESZ & JACK LIENKE, STRUGGLING FOR AIR: POWER PLANS AND THE "WAR ON COAL," with Revesz calling the grandfathering provisions of old stationary sources the "tragic flaw" of the Clean Air Act).
166. 42 U.S.C. § 7502(c)(1) (2012).
167. *Id.* § 7410(a)(2)(A).
168. *See* INTEGRATED SCIENCE ASSESSMENT FOR SULFUR OXIDES (2017), at 1-8 to 1-9 (describing exposure).

source consequences, emissions factors may create a significant problem by masking exposure to emissions from stationary sources and consequent health effects for those who live near them.

The PM 2.5 standard was adopted in 1997, but it was not until 2008 that states submitted SIPs that either demonstrated how they would maintain attainment status or come into attainment.[169] The attainment designations themselves, along with the SIPs, were based largely on emissions factors for stationary and mobile sources.[170] Indeed, emissions inventories for PM 2.5 continue to rely extensively on emissions factors to estimate emissions from fuel combustion, refineries, and so forth.[171]

The 2006 OIG report about emissions factors cautioned EPA about the importance of developing emissions factors based on good data.[172] It is difficult to determine, however, whether EPA heeded this advice. A 2004 report commissioned by the U.S. Department of Energy cautioned that:

> There are few existing data regarding emissions and characteristics of fine aerosols from oil, gas and power generation industry combustion sources, and the information that is available is generally outdated and/or incomplete. Traditional stationary source air emission sampling methods tend to underestimate or overestimate the contribution of the source to ambient aerosols because they do not properly account for primary aerosol formation, which occurs after the gases leave the stack.[173]

If emissions factors are systematically overestimating PM 2.5 from these sources, there should not be a problem with near-source exposure. Not only are the sources producing fewer emissions than emissions factors estimate, but regulated parties are also likely to challenge the application of emissions estimates that subject them to more stringent regulation than they would experience with accurate estimates.

But if emissions factors systematically underestimate emissions from stationary sources, like refineries and power plants, our current system of regulation is unlikely to detect these problems. This is likely to be particularly

169. *See* U.S. EPA, EPA CAN IMPROVE EMISSIONS FACTORS DEVELOPMENT AND MANAGEMENT, *supra* note 120, at 14 (describing role of emissions factors in PM 2.5 process).
170. *See id.* at 4–6.
171. *See* U.S. EPA, EPA'S REP. ON THE ENVIRONMENT, PARTICULATE MATTER EMISSIONS, https://cfpub.epa.gov/roe/indicator.cfm?i=19 [https://perma.cc/ZT92-MJWX] (last visited Dec. 28, 2017).
172. *See* OFFICE OF INSPECTOR GENERAL, EMISSIONS FACTORS REPORT, *supra* note 120, at 15.
173. GLENN C. ENGLAND, DEVELOPMENT OF FINE PARTICULATE EMISSION FACTORS AND SPECIATION PROFILES FOR OIL-AND GAS-FIRED COMBUSTION SYSTEMS ix (2004).

true in attainment areas where existing stationary sources are subject to virtually no regulation. These sources are not required to monitor their emissions if they are not otherwise subject to regulation. Moreover, monitoring requirements for PM 2.5 do not require microscale monitoring and thus are unlikely to detect near-source emissions from a stationary source.[174]

Even in nonattainment areas, the use of emissions factors may underestimate near-source emissions from stationary sources and our regulatory apparatus to regulate NAAQS is not well-suited to respond. The monitoring to determine nonattainment, again, is not likely to detect these emissions since the monitoring is at a broader scale. Moreover, existing stationary sources enjoy much more favorable treatment than new sources and thus would not be required to install control technology as effective as that required of new sources.[175]

V. CAN THE CURRENT CAA WORK TO ADDRESS NEAR-SOURCE POLLUTION?

A. In the Long Run, Greenhouse Gas Emissions Regulation May Ultimately Solve the Problem

1. Mobile Sources

Ironically, the problem of microclimate pollution may ultimately be resolved because of a pollution problem at the opposite end of the planetary scale, climate change. Solutions aimed at mitigating climate change will, however, take multiple decades, and, in the meantime, communities that live near highly polluted sources will continue to breathe unhealthful air.

Although greenhouse gas (GHG) emissions, in adding to heat-trapping gases that envelop the planet, create the exact opposite problem of pollution hotspots in their global scale, a large percentage of GHG emissions come from the same sources that create near-source pollution.[176] The transportation and electricity sectors are collectively responsible for more than half of GHG emissions in the United States. When industrial sources are included, the total

174. See discussion of monitoring requirements at notes 106–112, *supra.*
175. See discussion of existing new sources at notes 163–164, *supra.*
176. *See* U.S. EPA, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS, https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks [https://perma.cc/29F3-BES5] (last visited Aug. 14, 2017).

rises to nearly 80 percent.[177] Many observers suggest that the most effective long-run strategy to reduce emissions from the transportation sector is to electrify the vehicle fleet.[178] The electricity used to charge vehicles would come largely from renewable sources, combined with battery storage and other non-carbon mechanisms, eventually making fossil fuel power plants and oil refineries unnecessary or much less prevalent.[179] The major hotspot sources would, in other words, be clean. And the Clean Air Act in its current form could be used to achieve this transition.

How the CAA came to cover greenhouse gases is a well-known story, beginning with the U.S. Supreme Court's holding in *Massachusetts v. EPA* that greenhouse gases are pollutants under the Act and that EPA must determine whether they endanger public health and welfare.[180] Based on that authority, EPA under President Obama made the endangerment finding[181] and then issued two rounds of regulatory requirements focused on vehicles, including passenger, medium, and heavy duty.[182] The details of the standards are less important than the fact of them: The National Highway Transportation and Safety Authority worked with EPA for the first time to issue combined fuel economy standards and GHG regulations to bolster fuel economy from all categories of vehicles.[183] The standards were designed to be the first step on the road to much deeper decarbonization by mid-century.[184]

177. *See id.*
178. *See, e.g.*, MIT & SLOAN AUTO. LAB. ENG'G SYS. DIV., ON THE ROAD TOWARD 2050: POTENTIAL FOR SUBSTANTIAL REDUCTIONS IN LIGHT-DUTY VEHICLE ENERGY USE AND GREENHOUSE GAS EMISSIONS 18 (John Heywood & Don MacKenzie eds., 2015).
179. *See* SUSTAINABLE DEV. SOL. NETWORK, PATHWAYS TO DEEP DECARBONIZATION IN THE UNITED STATES, at vii (U.S. 2050, vol. 1, Technical Report Executive Summary (2015)).
180. 549 U.S. 497 (2007). For an account of how the CAA has been used to address GHG regulations, see generally Ann Carlson, *An Ode to the Clean Air Act*, 30 J. LAND USE & ENVTL. L. 119 (2014).
181. *See* U.S. EPA, ENDANGERMENT AND CAUSE OR CONTRIBUTE FINDINGS FOR GREENHOUSE GASES UNDER THE SECTION 202(A) OF THE CLEAN AIR ACT, https://www.epa.gov/ghgemissions/endangerment-and-cause-or-contribute-findings-greenhouse-gases-under-section-202a-clean [https://perma.cc/X85V-4Y48] (last visited Aug. 18, 2017).
182. For an explanation of all of the regulatory programs, see JAMES E. MCCARTHY & BRENT D. YACOBUCCI, CONG. RESEARCH SERV., R40506, CARS, TRUCKS AND CLIMATE CHANGE: GREENHOUSE GASES FROM MOBILE SOURCES 3–17 (2016). *See also* U.S. EPA, REGULATIONS FOR GREENHOUSE GAS EMISSIONS FROM PASSENGER CARS AND TRUCKS, https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-greenhouse-gas-emissions-passenger-cars-and [https://perma.cc/SS5T-J39L] (last visited Aug. 18, 2017).
183. *See* MCCARTHY & YACOBUCCI, *supra* note 182, at 3.
184. *See* U.S. Cover Note, INDC and Accompanying Information (Mar. 31, 2015), http://www4.unfccc.int/ndcregistry/PublishedDocuments/United%20States%20of%20America%20First/U.S.A.%20First%20NDC%20Submission.pdf (describing U.S. climate

At least some of the new regulatory requirements are currently under review by the Trump Administration, and passenger vehicle standards for model years 2021–2025 and standards for glider kits (which combine new trailers with refurbished engines) are likely to be loosened or eliminated.[185] As of this writing, EPA has just issued a revision of a required midterm review stating that the 2022–2025 model year standards are not economically or technologically feasible.[186] The expectation is that the administration will roll back those standards in some way.[187] But because of the special CAA authority California has to regulate mobile sources, the state has already recommitted to maintaining the current standards, has been granted a waiver by EPA to do so, and is investing massive resources into electrifying its vehicle fleet.[188] The state also has a regulatory mandate that 22 percent of vehicles be zero-emission by 2025.[189] Twelve states follow California's vehicle standards, covering more than a third of the country's vehicles.[190] Whether EPA will attempt to revoke the California waiver is unclear as of press time.[191]

---

commitment as part of a long-term strategy to cut U.S. emissions by 80 percent by 2050).

185. *See* U.S. EPA, EPA ANNOUNCES INTENT TO REVISIT PROVISIONS OF PHASE 2 HEAVY-DUTY RULES (Aug. 17, 2017) [hereinafter EPA ANNOUNCES INTENT TO REVISIT PROVISIONS], https://www.epa.gov/newsreleases/epa-announces-intent-revisit-provisions-phase-2-heavy-duty-rules [https://perma.cc/2AAF-JHB3]; U.S. EPA, EPA TO REEXAMINE EMISSIONS STANDARDS FOR CARS AND LIGHT DUTY TRUCKS—MODEL YEARS 2022-2025 (Mar. 15, 2017) [hereinafter EPA to Reexamine Emissions Standards], https://www.epa.gov/newsreleases/epa-reexamine-emission-standards-cars-and-light-duty-trucks-model-years-2022-2025 [https://perma.cc/4SEB-5LGH]; U.S. EPA, EPA, DOT OPEN COMMENT PERIOD ON RECONSIDERATION OF GHG STANDARDS FOR CARS AND TRUCKS (Aug. 10, 2017) [hereinafter EPA, DOT OPEN COMMENT PERIOD], https://www.epa.gov/newsreleases/epa-dot-open-comment-period-reconsideration-ghg-standards-cars-and-light-trucks [https://perma.cc/Q9T8-5VNC] (adding Model Year 2021 standards for reconsideration).
186. EPA Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022–2025 Light-Duty Vehicles, 83 Fed. Reg. 16,077 (April 13, 2018).
187. *See* Hiroko Tabuchi, *Calling Car Pollution Standards 'Too High,' E.P.A. Sets Up Fight With California,* N.Y. Times (April 2, 2018), https://www.nytimes.com/2018/04/02/climate/trump-auto-emissions-rules.html.
188. *See* Press Release, CARB Finds Vehicle Standards are Achievable and Cost-Effective, Cal. Air Res. Bd. (Mar. 24, 2017), https://www.arb.ca.gov/newsrel/newsrelease.php?id=908 [https://perma.cc/P6JR-EMPU] (describing state re-affirmation of vehicle standards); GOVERNOR'S INTERAGENCY WORKING GRP. ON ZERO-EMISSION VEHICLES, 2016 ZEV ACTION PLAN: AN UPDATED ROADMAP TOWARD 1.5 MILLION ZERO-EMISSION VEHICLES ON CALIFORNIA ROADWAYS BY 2025 (2016) (outlining state programs).
189. CAL. CODE REGS. Tit 13, § 1962.2(b)(1)(a) (2017).
190. *See* CARB Finds Vehicle Standards Are Achievable and Cost-Effective, *supra* note 188.
191. *See* Tabuchi, *supra* note 187.

The current regulatory environment at the federal level is, to say the least, dispiriting with respect to the regulation of greenhouse gases. Moreover, technological challenges remain in electrifying or moving to zero-emissions engines, particularly with respect to the electrification of heavy-duty engines for long-distance travel at reasonable cost.[192] Before long-distance trucks are fully electrified, we may be more likely to see hybrid trucks and improved diesel efficiency,[193] particularly if EPA and/or California use their authority to require additional improvements. Nevertheless, over the long haul, EPA and California collectively have the tools to address the biggest culprit in near-source exposure. The effort will take decades, and the problem of existing engine pollution will remain long after regulations are adopted for new engines. But the problem of climate change may ultimately provide us with the solution to near-road pollution. In fact, the significant and immediate health benefits that would result from dramatically eliminating or reducing entirely the biggest hotspot problem, near-road pollution, could be a more effective and persuasive way, rather than relying on arguments about climate change, to convince the public and its representatives that we should transition away from a fossil-fuel dominated transportation sector.

2. The Power Sector's Transition to Renewable Fuels Will Help the Stationary Source Problem

The Clean Air Act can also assist with the transition of the electricity sector from fossil fuels to renewable energy sources, and market forces in the sector, as well as state policies, are also helping.[194] As with GHG regulations for mobile

192. *See, e.g.*, Peter Fairley, *Can Tractor-Trailers Go Electric Along With Cars?* MIT TECH. REV. (July 29, 2015), https://www.technologyreview.com/s/539741/can-tractor-trailers-go-electric-along-with-cars [https://perma.cc/VX2F-2SAE].
193. *See id.*
194. Twenty-nine states currently have Renewable Portfolio Standards that require their utilities to procure a certain percentage of energy from renewable sources. *See* Jocelyn Durkay, *State Renewable Portfolio Standards and Goals*, NAT'L CONF. ST. LEGISLATURES (Aug. 1, 2017), http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx [https://perma.cc/AU69-4ZMT]. 2016 saw record renewable energy installations around the world, fueled in large measure by dropping prices. *See* Damian Carrington, '*Spectacular' Drop in Renewable Energy Costs Leads to Record Global Boost*, GUARDIAN, (June 6, 2017, 6:30 PM), https://www.theguardian.com/environment/2017/jun/06/spectacular-drop-in-renewable-energy-costs-leads-to-record-global-boost [https://perma.cc/8GKQ-V74D].

sources, however, the Trump Administration is rolling back CAA regulations for the power sector.[195]

Once EPA made its finding in 2009 that greenhouse gases endanger public health and welfare, the finding set off a cascade of regulatory activity focused on different sources of greenhouse gases.[196] The Obama Administration's Clean Power Plan (CPP) included regulations for new and existing electric generating units.[197] The CPP would, if implemented, cut GHG from the power sector by more than 30 percent below 2005 levels.[198] Importantly, the cuts were based in part on assumptions that the power sector could increase its reliance on renewable, as opposed to fossil, fuels.[199] The regulations would, in other words, begin to transition away from many of the stationary sources that can cause near-source pollution. Though its implementation is highly unlikely given that the Trump Administration has begun proceedings to withdraw the rule, the point is that the CAA in its current form contains mechanisms to reduce greenhouse gas emissions from stationary sources—mechanisms that could, in turn, reduce particulate and NO2 pollution that cause human health problems.[200] Indeed, EPA estimated that the CPP would prevent between 1400 and 3200 premature deaths and 1700 heart attacks, largely from reductions in PM 2.5 and ozone.[201]

195. Review of the Clean Power Plan, 82 Fed. Reg. 16,329 (proposed Apr. 4, 2017) (to be codified at 40 C.F.R. pt. 60) (notice of review of Clean Power Plan (CPP)).
196. For an explanation of this regulatory cascade, see Carlson, *supra* note 180.
197. For a snapshot of EPA's website containing extensive materials about the CPP, including an in-depth description and regulatory materials, see U.S. EPA, OVERVIEW OF THE CLEAN POWER PLAN, CUTTING CARBON POLLUTION FROM POWER PLANTS, https://19january2017snapshot.epa.gov/cleanpowerplan/fact-sheet-overview-clean-power-plan_.html [https://perma.cc/L3HP-ECCW]. The EPA materials about the CPP are no longer available from EPA itself. *Id.* Instead, EPA Administrator Scott Pruitt has launched a review of the CPP and has made clear that he intends to withdraw the rule. *See* Review of the Clean Power Plan, 82 Fed. Reg. at 16,329.
198. *See* U.S. EPA, OVERVIEW OF THE CLEAN POWER PLAN, CUTTING CARBON POLLUTION FROM POWER PLANTS, *supra* note 197.
199. *Id.*
200. The legal status of the CPP was, and remains, uncertain. Numerous regulated parties and a coalition of states led by now EPA Administrator Scott Pruitt, who was the Attorney General of Oklahoma, challenged the plan as outside the scope of EPA's statutory authority. This challenge is pending in the U.S. Court of Appeal for the D.C. Circuit, and the case is currently under abeyance.
201. *See* EPA, REGULATORY IMPACT ANALYSIS FOR THE CLEAN POWER PLAN FINAL RULE, 4–31 (2015). A number of policies and sharp drops in the price of solar and wind technology have led to large increases in wind and solar installations over the past decade. Researchers estimate that this shift from conventional to renewable energy sources has resulted in a reduction in premature deaths of between 3000 and 12,700, and an increase in cumulative economic benefits of between $35 billion and more than $200 billion.

B. In the Nearer Term, CAA Contains Some Potential Regulatory Avenues for Attacking Near-Source Pollution

1. Transportation Control Measures

One potential method for addressing near-source roadway pollution is through transportation control measures, such as the management and flow of traffic, the provision of alternative and cleaner forms of transportation, and the dedication of carpool lanes. While these approaches to reducing near-road exposure are indirect, as compared to direct emissions controls on mobile sources, they can in the short run help reduce emissions levels on heavily trafficked roads.[202]

Though the CAA, is in many ways, prescriptive in requiring states to implement provisions that can be quite directive, the Act's treatment of transportation control measures is striking for—the most part—failing to require any significant adoption of such measures.[203] States are not required to include transportation control measures in SIPs except in serious and extreme ozone nonattainment and serious nonattainment carbon monoxide zones (of which there are none) and for transportation conformity.[204] Even in these nonattainment areas, EPA has taken a remarkably narrow approach to what is required.

The Clean Air Act requires serious and severe ozone nonattainment areas "to offset any growth in emissions from growth in vehicle miles traveled . . . and to attain reduction in motor vehicle emissions as necessary . . . ."[205] In 2004, California submitted a SIP revision for the South Coast Air Quality Management plan to attain the ozone standard, a revision that EPA approved

Dev Millstein et al., *The Climate and Air-Quality Benefits of Wind and Solar Power in the United States*, 2 NATURE ENERGY 1, 1 (2017).

202. *See Multi-Pollutant Emissions Benefits of Transportation Strategies-FHWA*, U.S. DEP'T TRANSP. FED. HIGHWAY ADMIN. (Nov. 14, 2006), https://www.fhwa.dot.gov/environment/air_quality/conformity/research/mpe_benefits [https://perma.cc/AQ5R-RPXU].

203. *See Transportation Control Measures*, U.S. DEP'T TRANSP. FED. HIGHWAY SAFETY ADMIN., http://www.fhwa.dot.gov/environment/air_quality/conformity/research/transportation_control_measures [https://perma.cc/DS5Z-ZVDJ] (describing transportation control measures).

204. In nonattainment zones for several of the criteria pollutants, states must ensure that new transportation projects do not interfere with federal air quality goals. For an explanation of this process, see Fed. Highway Admin., *Air Quality, Transportation Conformity*, https://www.fhwa.dot.gov/environment/air_quality/conformity (last visited March 28, 2018).

205. 42 U.S.C. § 7511a(d)(1)(A) (2012).

in 2009.[206] The plan contained no transportation control measures, even though SCAQMD is an extreme nonattainment zone for ozone.[207] California took the position that no transportation control measures were necessary, because, even though vehicle miles traveled (VMTs) would increase, overall emissions would decline as a result of other regulatory efforts. EPA agreed.[208] Plaintiff environmental groups challenged EPA's approval, and the court held that EPA's interpretation of the statutory language requiring transportation control measures was erroneous. Instead, the court found that the text requires transportation control measures if VMTs have grown over a previous baseline year to offset any emissions growth associated with that growth, not merely if overall emissions increase.[209]

Despite EPA's narrow interpretation, transportation control measures could be used if air districts are designated as out of attainment of the new NO2 one-hour standard. Similarly, were EPA to require near-road monitoring for PM 2.5 or establish a new PM 2.5 standard based on near-road pollution, transportation control measures could play a role in reducing exposure. Given that the standard is directed at near-road pollution and that air districts cannot directly regulate mobile source emissions, transportation control measures are, in fact, likely to be a primary means for controlling exposure. Whether air districts and EPA will have the political will to impose such measures is a different matter.[210]

2. Indirect Source Rules To Control New or Modified Sources

The CAA contains another provision that can be used to control mobile source emissions from new or modified sources that are stationary, but the provision is entirely permissive. Section 110(a)(5) authorizes—but does not require—states to adopt indirect source review to include in State Implementation Plans for new or modified "indirect sources" that will attract emissions from mobile sources.[211] Indirect sources are defined to include "a facility, building, structure, installation, real property, road, or highway

206. Ass'n of Irritated Residents v. EPA, 686 F.3d 668, 672–73 (D.C. Cir. 2011).
207. *Id.* at 673.
208. *Id.*
209. *Id.* at 680–81.
210. *See, e.g.*, U.S. GOV'T ACCOUNTING OFFICE, GAO/RCED-93-169, URBAN TRANSPORTATION: REDUCING VEHICLE EMISSIONS WITH TRANSPORTATION CONTROL MEASURES 3 (1993) (describing some TCMs as "politically painful").
211. 42 U.S.C. § 7410(a)(5)(A) (2012).

which attracts, or may attract, mobile sources of pollution."[212] States using this provision can regulate emissions from the indirect source in order to maintain or come into compliance with a NAAQS even when the cause of those emissions is mobile sources (construction equipment, for example).[213] States do need, however, to ensure that they do not impose direct emissions controls on mobile sources that increase indirect source emissions or they risk running afoul of the mobile source preemption provisions.[214]

The indirect source provision appears to be underutilized but has been used by some air districts, including California's Central Valley, to impose limitations on mobile source emissions on construction sites. Like the transportation control measures described above, the indirect source rule applies only to new or modified sources, not existing ones, so cannot alone solve the problem of pollution hot spots. Nevertheless it is another underutilized mechanism that can address hot spots that arise from new development and construction.

3. Creative Interpretations of Existing CAA Provisions to Tackle Near-Road Pollution

EPA might also use its existing regulatory authority creatively to attempt to require states to address near-source and, particularly, near-road pollution.[215] To begin with, the NAAQS provisions themselves require EPA to establish ambient standards in a way that is sufficient to "protect the public health" with "an adequate margin of safety."[216] This language should provide the agency with sufficient authority to establish mechanisms to regulate near-source pollution and arguably could provide a basis for a citizen suit against the agency for failing to do so. One obvious possibility is to create a near-source standard for PM 2.5 similar to the new NO2 standard. The agency could also explore more unusual regulatory measures, such as establishing air districts for a particular pollutant (PM 2.5 is the obvious one) that encompass only the areas near trafficked roadways or determining that highways are stationary sources.

212. Id. § 7410(a)(5)(C).
213. Id. § 7410(a)(5)(D).
214. *See* Nat'l Ass'n of Home Builders v. San Joaquin Valley Unified Air Pollution Control Dist., 627 F.3d 730, 734–35 (9th Cir. 2010) (discussing tension between CAA mobile source preemption provision and indirect source provision and upholding San Joaquin Air District's rule).
215. These suggestions are preliminary in nature and offered merely to suggest that the expansive nature of and language in the CAA might be deployed to address hotspot pollution.
216. 42 U.S.C. § 7409(b)(1) (2012).

These are preliminary suggestions and raise many complexities, but they highlight the fact that the CAA is a remarkably flexible and expansive statute that can evolve as new pollution problems come to light.[217]

4. State Solutions to Near-Source Pollution

Finally, EPA might look to a number of solutions that some states, particularly California, have adopted in an attempt to address near-source pollution. None of these fully fix the problem in the way that a fully electrified vehicle fleet would, but they can nevertheless reduce exposure levels and consequent health effects of breathing in elevated levels of pollutants and serve as transition measures, as the vehicle fleet turns over and moves toward zero emissions. And of course, other than preemption provisions in the Clean Air Act for new engine emissions standards, nothing prohibits states from attempting to address the near-source problems voluntarily.

Most importantly, California now requires the retrofitting of existing heavy-duty diesel engines and the eventual replacement of old diesel trucks with new technology.[218] Some of this regulatory activity stems from California's special authority to regulate emissions under the Clean Air Act[219] but the requirement that older heavy-duty trucks install engine filters could be done by other states.[220] Other states can also choose to follow new California emissions standards.[221] Though California does not control emissions from all trucks that enter the state, it is still regulating a substantial portion of truck traffic that contributes to near-road emissions.

California's two largest ports, Los Angeles and Long Beach, have also adopted extensive regulatory programs to address port emissions, primarily from mobile sources with diesel engines, including heavy trucks, drayage, and even ocean vessels.[222] The mayors of the two cities that house the ports just

217. For an evaluation of many of the ways in which the CAA has proved adaptable, flexible, and durable, see THE FUTURE OF LONG-TERM ENERGY POLICY: LESSONS FROM THE CLEAN AIR ACT (Dallas Burtraw & Ann E. Carlson eds., forthcoming 2018).

218. *Truck and Bus Regulation: On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation*, CAL. AIR RES. BD., https://www.arb.ca.gov/msprog/onrdiesel/onrdiesel.htm [https://perma.cc/4FE3-AMS2] (last reviewed Dec. 14, 2017).

219. *See* 42 U.S.C. § 7543(b) (2012).

220. The preemption of state emissions standards for motor vehicles applies to new vehicles. *See id.* § 7543(a).

221. *Id.* § 7507.

222. *See San Pedro Bay Ports Clean Air Action Plan (CAAP)*, PORT L.A., https://www.portoflosangeles.org/environment/caap.asp [https://perma.cc/UYG3-7U5X].

committed to zero emissions from cargo-handling equipment by 2030 and from drayage trucks by 2035.[223]

California is also embarking on a new monitoring program to obtain better data about near-source exposure in disadvantaged communities and to install control measures on sources that are contributing to elevated near-source levels.[224]

Finally, California and some of its localities have restricted some land uses near freeways, including elementary schools,[225] and have required air filters in housing located near major highways.[226] Nevertheless, there are no barriers to the construction of new housing near freeways and a recent study showed that Los Angeles County has 169 child care centers—which, unlike schools, can be built near freeways—located within 500 feet of a freeway.[227]

EPA could look to some of these state solutions, particularly those involving the retrofitting of old heavy-duty engines, as measures available to other states with near-road pollution problems. To do so, however, EPA would need to take other steps outlined above to identify and require the regulation of near-source pollution in order to shoehorn the problem of near-road exposure into the existing statutory structure.

None of these regulatory measures is a magic bullet to solve the microclimate pollution problem. One lesson from the many years of Clean Air Act implementation, however, is that the process of cleaning the air has involved relying on numerous statutory provisions, adopting many iterations of regulations, and engaging in sustained effort to identify and regulate new pollution problems.[228] A legislative solution to the hotspot pollution problem

223. *See* Joint Declaration, Eric Garcetti & Robert Garcia, *Creating a Zero Emissions Goods Movement Future: A Joint Declaration of the Mayors of the Cities of Los Angeles and Long Beach*, https://www.documentcloud.org/documents/3864912-Joint-declaration-of-L-A-Long-Beach-mayors-on.html.

224. *See* Cal. Air Res. Bd., Community Air Protection Program, AB 617 (last viewed March 28, 2018).

225. CAL. PUB. RES. CODE § 21151.8(a)(1)(D) (2009).

226. *See* Tony Barboza, *L.A. Requires Air Filters to Protect Residents Near Freeways. Are They Doing Their Job?*, L.A. TIMES (July 9, 2017, 5:00 AM), http://www.latimes.com/local/lanow/la-me-ln-freeway-pollution-filters-20170709-story.html [https://perma.cc/NLX3-JR6R] (suggesting that the requirement is not well-enforced and the systems often not well-maintained).

227. *See* Deepa Fernandes with Aaron Mendelson, *Polluted Preschools: 169 LA Childcare Centers Are Too Close to Freeways*, 89.3 KPCC, (Mar. 29, 2016), http://www.scpr.org/ news/2016/03/29/58878/pollution-near-preschools-is-impacting-nearly-10-0 [https://perma.cc/5HQY-W87W].

228. For an in-depth analysis of the multiple iterations of passenger vehicle regulations in California and at the federal level, see generally Ann E. Carlson, *Iterative Federalism and*

might well be preferable, but, in the current legislative climate, reform is highly unlikely.

CONCLUSION

The very successful ambient structure of the Clean Air Act may, ironically, also help to mask a ubiquitous and harmful form of pollution: hotspots of emissions in microclimates. Indeed, by requiring air districts around the country to measure, monitor, and regulate pollutants on a large, background scale, the CAA may actually lead residents to misunderstand the health risks they face from the air they breathe. In some instances, background ambient air may actually be cleaner than the labels some air districts receive when out of attainment—this is the case for large parts of Los Angeles that have cleaner ambient air than the air measured by monitors in the dirtiest parts of the basin. But much more troubling, the imprimatur of clean air in many districts may also lead residents to believe the air they breathe is of high quality even when living or playing or working in a microclimate with predictably unhealthful air. These measurements, monitors, and labels may even lull regulators into believing their jobs are done when many of their residents—often the lowest income and disproportionately of color—face unhealthful conditions during many parts of the day. The microclimates that remain largely (though not entirely) unregulated are, in my view, the blindspot of the CAA. This Article is an effort to make us see what the ambient focus of the Act has kept hidden.

Climate Change, 103 NW. U. L. REV. 1097 (2009); *see also* THE FUTURE OF LONG-TERM ENERGY POLICY: LESSONS FROM THE CLEAN AIR ACT, *supra* note 217.