Union of Concerned Scientists

FACT SHEET

Inequitable Exposure to Air Pollution from Vehicles in Massachusetts

Who Bears the Burden?

HIGHLIGHTS

Cars, trucks, and buses contribute significantly to particulate matter air pollution in Massachusetts, with disproportionate effects on communities of color. Clean transportation policies—such as those that encourage vehicle electrification, cleaner fuels, and reduced driving—will help reduce these emissions. Additionally, Massachusetts policymakers should evaluate and place a high priority on investments in clean transportation and other clean transportation strategies for their ability to reduce inequities in exposure to vehicular air pollution. Quantitative evidence of such inequities in the state's air pollution helps to inform such evaluations.

Tailpipe emissions from cars, trucks and buses are a leading source of harmful air pollution in Massachusetts. This pollution has a significant impact on the health of the region's residents, and varies greatly geographically and across different types of communities in the Commonwealth. An analysis from the Union of Concerned Scientists (UCS) quantifies the formation of particulate matter air pollution from on-road vehicles in Massachusetts. It also identifies the locations and populations burdened with the highest exposure to these transportation emissions.

Research links exposure to particulate matter smaller than 2.5 micrometers in diameter ($PM_{2.5}$)—20 times smaller than even fine human hair—to increased illness and death, primarily from heart and lung diseases. The UCS analysis finds that Asian American, African American, and Latino residents of Massachusetts, as well as people of other races, are exposed to higher $PM_{2.5}$ pollution from cars, trucks, and buses than are white residents. More specifically, the research finds that:

- Asian American residents in Massachusetts are exposed to $PM_{2.5}$ concentrations from on-road transportation that are, on average, 36 percent higher than the exposure of white residents. African American residents are exposed to 34 percent more vehicle pollution than are white residents, and Latino residents to 26 percent more.

Billy Hathorn/Creative Commons (Wikimedia Commons)

Fine particulate pollution from cars, trucks, and buses on Massachusetts' roads have a disproportionate burden on communities that live near these roads. People of color are exposed to more of this pollution than white residents.

- In areas where $PM_{2.5}$ concentrations are more than 200 percent of the Massachusetts average, white residents make up just 56 percent of the population, although white residents comprise almost 75 percent of the state. On the other hand, in areas with concentrations below the state average, white residents constitute 81 percent of the population. Almost 70 percent of all white residents live in areas with concentrations below the state average.
- More than 372,000 Latino residents, 283,000 African American residents, and 231,000 Asian American residents live in areas of Massachusetts where pollution is above the state average.

The inequitable exposure of communities of color to transportation pollution reflects decades of decisions in Massachusetts about transportation, housing, and land use. Decisions about where to place highways, where to invest in public transportation, and where to build housing have all contributed to a transportation system that concentrates emissions on communities of color. In many cases, local, state, and federal transportation policies have left communities of color with inadequate access to public transportation, divided by highways, and breathing air polluted by congested highways serving suburban commuters.

New clean transportation technologies, such as electric trucks, buses, and passenger vehicles, give us the opportunity to begin to rectify this injustice. They have the potential to reduce and ultimately eliminate the use of diesel and gasoline in our on-road vehicle fleet. Improving public transportation services, improving the infrastructure for walking and biking, and increasing the supply of affordable housing in communities close to transit can help households in Massachusetts drive less or even go car-free.

These clean transportation technologies must serve the communities that need them the most. In the long run, electric transit buses, school buses, and cars will save money, but few low- and moderate-income consumers, school districts, or transit agencies can afford the up-front cost of these technologies without assistance. As we continue to invest in our public transportation system, new policies and new resources will help ensure that it provides the required high-quality services in Boston and throughout the state. As Massachusetts and other states in the Northeast and Mid-Atlantic move to create clean, modern transportation systems, they should prioritize investments that will directly benefit communities that currently bear the greatest burden from transportation pollution.

Why Particulate Matter Air Pollution Is a Problem

$PM_{2.5}$ is the largest environmental health risk factor in the United States, responsible for 63 percent of deaths from environmental causes (Tessum et al. 2019; Tessum, Hill, and Marshall 2014). These particles are small enough to penetrate deeply into the lungs. The smallest can even enter the bloodstream (Donaldson et al. 2013).

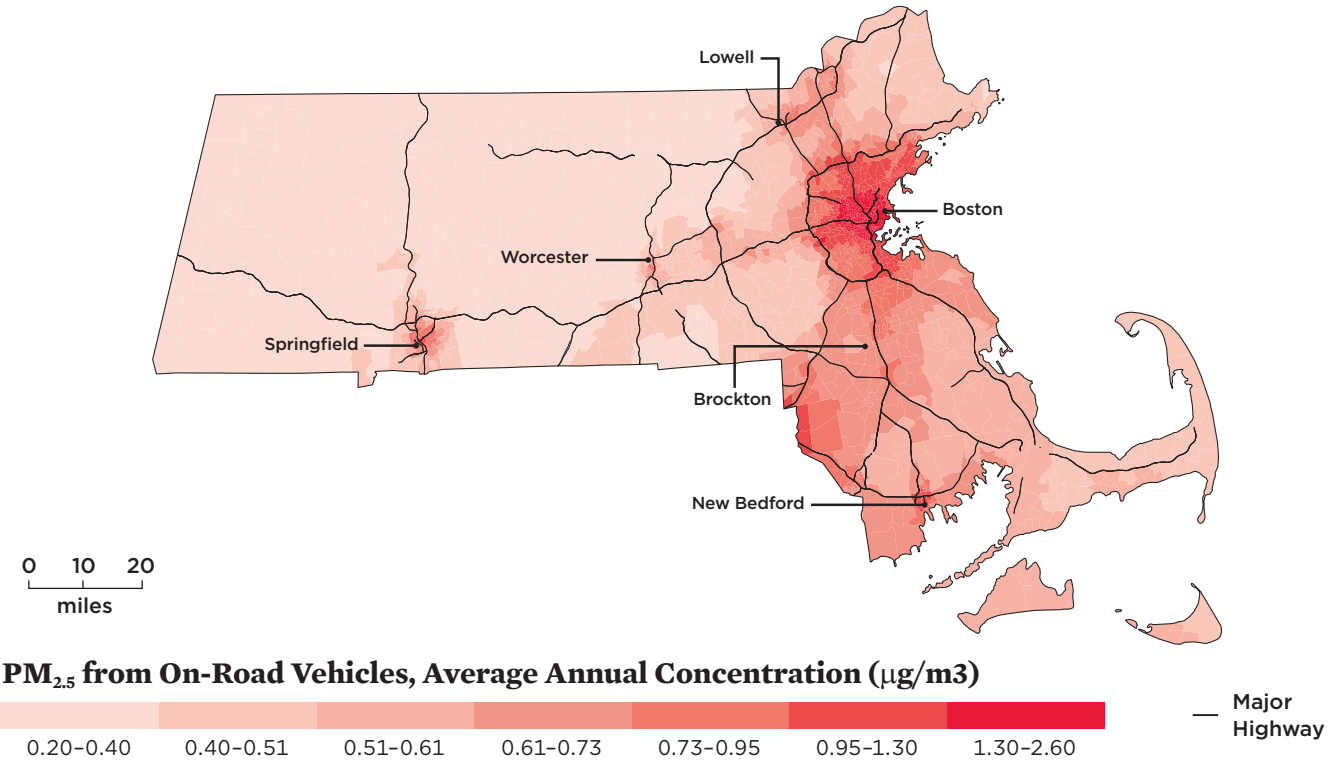
Exposure to $PM_{2.5}$ has significant negative health impacts. It has been estimated that fine particulate air pollution is responsible for almost all of the 3 million to 4 million annual deaths attributed to air pollution worldwide. $PM_{2.5}$ is estimated to be responsible for about 95 percent of the global public health impacts from air pollution, even if it is not the only air pollutant that adversely affects health (Landrigan et al. 2018; Lelieveld et al. 2015).

Both acute and chronic exposure to $PM_{2.5}$ have been linked to illness and death (Guo et al. 2018; Pagalan et al. 2018; Achilleos et al. 2017; Brook et al. 2010). Short-term exposure to elevated levels of $PM_{2.5}$ can exacerbate lung and heart ailments, cause asthma attacks, and lead to both increased hospitalizations and mortality from cardiovascular diseases (Orellano et al. 2017; Pope and Dockery 2006). Chronic exposure to $PM_{2.5}$ also causes increased death rates attributed to cardiovascular diseases, including heart attacks, and it has been linked to lung cancer and other adverse impacts (Fine, Sioutas, and Solomon 2008). Chronic exposure to $PM_{2.5}$ in children has been linked to slowed lung-function growth and the development of asthma, among other negative health impacts (ALA 2018; Gehring et al. 2015; Gauderman et al. 2004).

In Massachusetts, the combined health and climate costs in 2015 attributable to passenger vehicles were about $2.9 billion. Health cost estimates amount to about two-thirds of this total; they include premature deaths, heart attacks, asthma attacks, emergency room visits, and lost work days resulting from breathing pollution associated with passenger cars (Holmes-Gen and Barrett 2016).

Fine particulate air pollution is responsible for almost all of the 3 million to 4 million annual deaths attributed to air pollution worldwide.

FIGURE 1. High Variation in Exposure to $PM_{2.5}$ Pollution from On-Road Vehicles in Massachusetts



Three Massachusetts counties have average $PM_{2.5}$ exposures higher than the state average. In Suffolk County, the most polluted, average concentration is 88 percent above the state average. Middlesex and Norfolk are the next most polluted, with concentrations 17 percent and 3 percent above the state average, respectively. High levels of $PM_{2.5}$ are found in pockets in Springfield, bordering I-91, as well as in areas of Massachusetts east of Providence, Rhode Island, bordering I-195.

SOURCES: US CENSUS BUREAU 2018; EPA 2014.

Analysis of $PM_{2.5}$ Pollution from On-Road Transportation

To estimate the average annual exposure and health impacts of particulate matter air pollution from cars, trucks, and buses, UCS modeled $PM_{2.5}$ concentrations in the Northeast and Mid-Atlantic due to emissions from vehicle tailpipes and vehicle refueling (Tessum, Hill, and Marshall 2014).[1] We estimated ground-level pollution exposure for each census tract, then combined that information with population and demographic data to understand how exposure to $PM_{2.5}$ varies among groups and locations.[2]

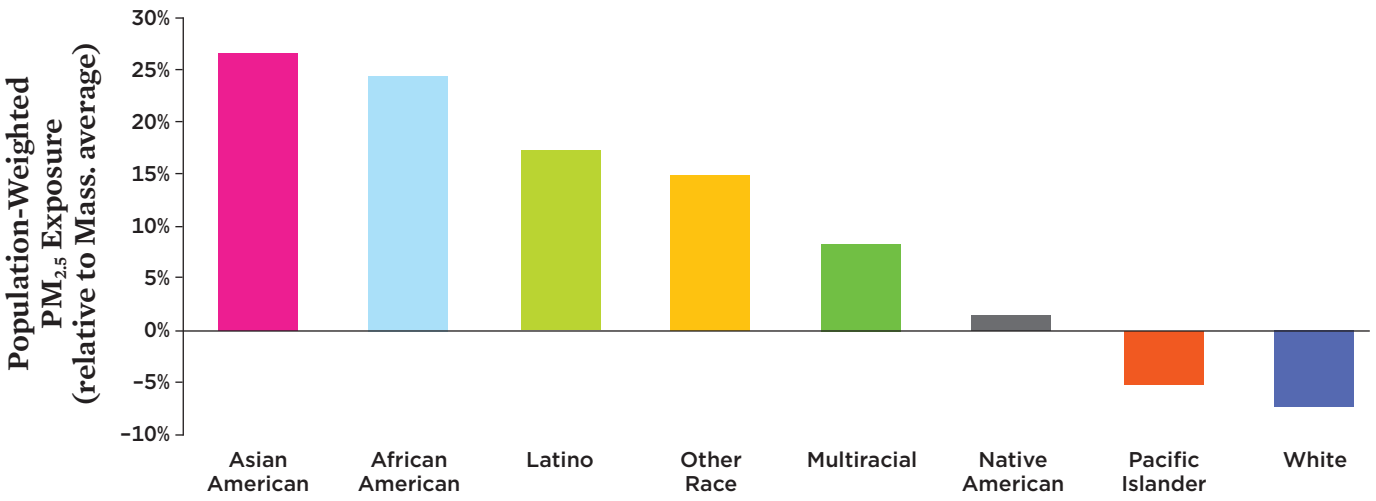
These estimates do not include $PM_{2.5}$ exposure from other types of transportation, such as airplanes, marine vessels, or trains. The $PM_{2.5}$ concentration and exposure modeling also excludes operations at freight facilities and ports. Their emissions would add to the exposures shown in this analysis. These other transportation and freight emissions can cause significant health impacts, especially for those who live closest to these facilities, leading to well-documented environmental justice concerns (Hricko 2008).

Geographically, pollution from vehicles is concentrated in downtown Boston, along the I-93 and I-95 corridors, and in gateway cities such as Fall River, Lawrence, Lowell, and New Bedford (Figure 1). Springfield, recently cited as the city with the nation's highest rate of asthma-related emergency room visits, has transportation emissions more than 43 percent higher than the state average (AAFA 2018). The census tract with the highest level of vehicle emissions in Massachusetts is in Boston's Chinatown, near the interchange between the Mass Pike and I-93.

Greater $PM_{2.5}$ Pollution for Asian Americans, African Americans, and Latinos

The $PM_{2.5}$ pollution burden from cars, trucks, and buses is inequitably distributed among racial groups in Massachusetts (Figure 2, p. 4, and Figure 3, p. 5). On average, $PM_{2.5}$ exposures

FIGURE 2. Disproportionately High Exposure for Asian American, African American, and Latino residents, and People of Other Races, in Massachusetts



Asian American residents have 26 percent higher exposure than the state average. African American residents have 24 percent higher exposures, and Latino residents have 17 percent higher exposures. Meanwhile, white residents are exposed to 7 percent lower concentrations.

Note: This analysis uses the definitions of racial groups according to US Census Bureau: White; Black or African American; American Indian or Alaska Native; Asian American; Native Hawaiian or Other Pacific Islander; Hispanic; Latino; and Some Other Race. In the chart, Latino includes census respondents who select Hispanic, Latino, or both; Other Race includes census respondents who select Some Other Race as their only race.

SOURCES: US CENSUS BUREAU 2018; EPA 2014.

from transportation for Asian American, African American, and Latino residents, as well as residents who self-identify in the census as "other race," are higher than for white residents. The UCS analysis finds that exposure inequalities are more pronounced between racial and ethnic groups than between income groups.

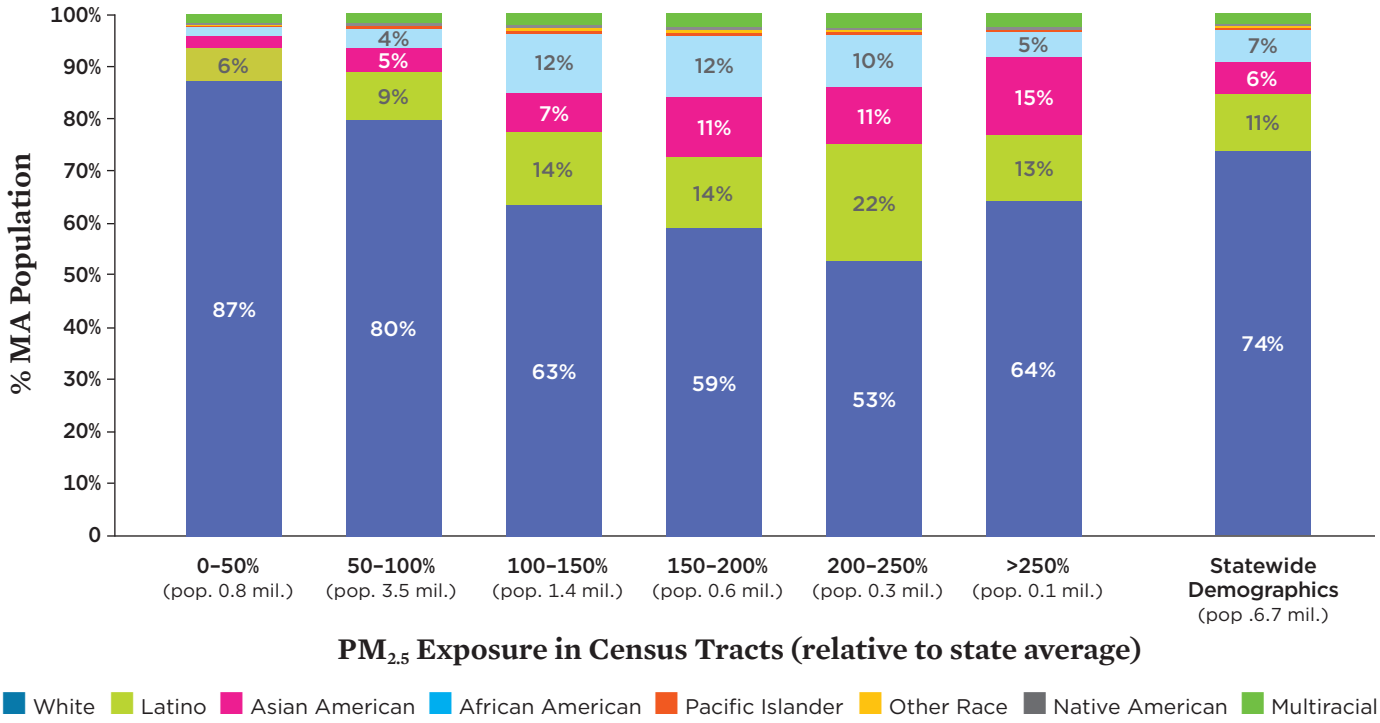
What We Can Do

Massachusetts residents want to live in communities with a wide variety of transportation choices, including high-quality regional rail, strong subway and bus systems, and good infrastructure for walking and biking. Proven technologies can help us transform the state's transportation system, moving it away from diesel and gasoline and toward clean, modern solutions. Battery-electric buses are operating right now in Massachusetts; with the right investments, they could eventually power our entire fleet of public transportation buses. Electric vehicles have no tailpipe emissions,[3] and they are improving with every passing year even as they become more affordable and increasingly available in a wide range of vehicle classes. The generation of the electricity used to charge the vehicle can produce some emissions, but these emissions are lower than those of an average gasoline car and vary depending on where the vehicle is charged (Reichmuth 2017). In the Northeast and Mid-Atlantic, the Regional Greenhouse Gas Initiative (RGGI), along with investments in solar, wind, and other renewable electricity sources, has greatly reduced emissions from electricity generation (RGGI 2019).[4]

Battery-electric buses are operating right now in Massachusetts; with the right investments, they could eventually power our entire fleet of public transportation buses.

Making these clean transportation technologies available to all will require significant up-front investments, yet the communities most affected by transportation pollution often have the fewest available resources. Significant new funding is necessary to expand access to clean transportation in these

FIGURE 3. As $PM_{2.5}$ Exposure Increases in Massachusetts, the Fraction of White Residents Decreases



In areas where $PM_{2.5}$ exposure is lower than the state average, the fraction of white residents is higher than the state fraction of white residents. In areas in the state where $PM_{2.5}$ exposure is higher than the state average, the fraction of white residents is lower than the state fraction of white residents. In the highest pollution areas, which correspond to urban centers with heavy traffic, the fraction of white residents is high but still lower than the state fraction of white residents.

Notes: Each column refers to census tracts in areas with similar $PM_{2.5}$ pollution concentrations. Columns show the fraction of people belonging to each of eight racial groups living in those areas. The least polluted areas are on the left and the most polluted on the right. The 0–50% area refers to census tracts where $PM_{2.5}$ pollution is below half the regional average; the 50–100% area refers to census tracts where pollution is from half the regional average to the regional average. The column at the far right shows the racial composition of the states.

This analysis uses the definitions of racial groups according to US Census Bureau: White; Black or African American; American Indian or Alaska Native; Asian American; Native Hawaiian or Other Pacific Islander; Hispanic; Latino; and Some Other Race. In the chart, Latino includes census respondents who select Hispanic, Latino, or both; Other Race includes census respondents who select Some Other Race as their only race.

SOURCES: US CENSUS BUREAU 2018; EPA 2014.

communities, as are strong regulations that limit transportation emissions and put a price on carbon pollution. Massachusetts should adopt a variety of policy approaches to support clean transportation in communities that are disproportionately affected by tailpipe pollution. Multiple approaches at the local, state, and regional levels can, and should, work together to ensure that the Commonwealth is a leader in reducing one of the most harmful sources of emissions.

In December 2018, Massachusetts and nine other jurisdictions in the Northeast and Mid-Atlantic agreed to create a regional program that would limit transportation emissions and invest in clean transportation. This effort could bring in $450 million per year for clean transportation investments in Massachusetts (Gatti 2017). A portion of these investments should be dedicated to programs that improve air quality in communities with the highest exposure to transportation pollution.

In addition, Massachusetts should ensure that all state investments in clean transportation consider equity. The state should seek input from communities disproportionately burdened by transportation pollution and ensure that equity is a key consideration in both design processes and future investment decisions. Investments in electric buses should focus first on serving communities with the highest concentration of diesel emissions. The state should expand its electric vehicle rebate program, MOR-EV, to provide financing assistance and larger up-front rebates to low- and moderate-income residents. Utility investments in the infrastructure for charging electric vehicles should prioritize investments

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Doug Brugge/CAFEH

People living near highways are exposed to high levels of vehicle pollution. Improved public transit, vehicle electrification, cleaner fuels, and reduced driving are critical to helping to reduce vehicle pollution and its associated health risks. Policymakers in Massachusetts should prioritize clean transportation investments in the communities most burdened by vehicle pollution.

in heavily affected communities and ensure that these programs serve renters and people without access to off-street parking. State programs to provide municipalities with aid to support clean transportation, such as Complete Streets and the Green Communities Act, should also target these communities.

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ENDNOTES

1 *Details on the modeling approach can be found at* www.ucsusa.org/air-quality-methodology.
2 *The average population of a census tract is 4,000.*
3 *There are minor amounts of* $PM_{2.5}$ *emissions from tire and brake wear.*
4 *Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont participate in RGGI. Virginia is preparing to join in 2020, and Pennsylvania is considering joining. New Jersey left RGGI in 2012 but is on track to rejoin in 2020. Partially because of RGGI, the region has reduced its emissions by about 40 percent relative to 2005 levels.*

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