Zero-emissions Boston could save 288 lives and $2.4 billion annually

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Air pollution from just the City of Boston contributes to nearly as many deaths across the wider region as car crashes do, as well as non-fatal cardiovascular and respiratory disease and days of missed work.

With much of the City of Boston shut down by COVID-19, the region is enjoying better air quality than it has seen in decades, a preview of the reduced emissions that will come as part of the city's ambitious "Carbon Free Boston" goals.

But what if Boston eliminated all emissions—and not just because of a pandemic, but for good? That is the question asked by a new Boston University School of Public Health (BUSPH) study published in the journal *Environmental Research Letters*.

The study estimates that a zero-emissions Boston would mean over 200 deaths avoided in the city (and the rest of Suffolk County) each year, with reductions in fatal and non-fatal cardiovascular and respiratory illness extending all the way from Worcester to Barnstable and into southern New Hampshire and northern Rhode Island, with 6 deaths avoided per 100,000 people in the whole region—which the researchers note is roughly equivalent to the Massachusetts motor vehicle crash fatality rate.

"Public health and climate policymaking are intertwined," says study lead author Matthew Raifman, a doctoral student in environmental health at BUSPH. "While Boston's climate policies are focused on reducing greenhouse gas emissions, these actions will also likely reduce deaths and improve the quality of life of residents of Boston and the surrounding region."

The researchers also estimated that the resulting decrease in medical costs and lost/reduced work could save $1.7 billion in Suffolk County, and $2.4 billion for the entire 75-square-mile zone modeled in the study.

"In showing the substantial health and economic benefits that clean air can bring to Boston area residents, this study demonstrates that climate action isn't just about saving the planet; it's also about making us healthier," says study senior author Dr. Patrick Kinney, Beverly Brown Professor of Urban Health and professor of environmental health at BUSPH.

Raifman, Kinney, and colleagues used the US Environmental Protection

Agency's Community Multiscale Air Quality model to estimate the 2011 emissions and air quality status quo for Boston and the surrounding 75 square miles, focusing on air pollutants known to harm health: PM2.5 (particulates with a diameter of less than 2.5 micrometers, or 3 percent of the diameter of a human hair) and O_3 (ozone). They then set the model's human-made emissions—including motor vehicles, generators, rail, industry, all oil- and gas-burning, shipping and boating, and residential wood fire—from within Boston's city limits to zero.

They found that a zero-emissions Boston would halve PM2.5 concentrations in the city itself, and slightly decrease concentrations for the rest of the modeled zone. Concentrations of ozone would also decrease across much of zone, although Boston and areas west of the city would actually see an increase in ozone during warmer months—which the researchers explain is because of the reduction in nitrogen oxide emissions that would normally transform ozone into other compounds.

The researchers then used the EPA's Environmental Benefits Mapping and Analysis Program (BenMAP) Community Edition v1.5 to estimate how these changes in PM2.5 and ozone would affect health at the county level. The health benefits from the decrease in PM2.5 would mainly override the health harms of increased ozone, resulting in 288 fewer deaths per year across the 75-square-mile area, mainly in Boston and the Greater Boston area. A zero-emissions Boston would also prevent 116 non-fatal heart attacks, 46 cardiovascular hospitalizations, 117 cases of chronic bronchitis, and over 17,000 asthma attacks across the zone, again mainly in Boston. However, the high ozone levels would increase emergency room visits for asthma and respiratory hospitalizations.

Looking at the effects by race and ethnicity, the researchers found that the greatest reduction in deaths and non-fatal health issues relative to population size would be in black residents, who the researchers note currently bear the greatest burden of environmental injustice and are

more likely to live in Boston than any other area in the larger modeled zone.

The researchers estimated that the decrease in deaths, hospitalizations, days of missed work, and other benefits of a zero-emission Boston would translate to savings of $1.7 billion for Suffolk County, $182 million for Norfolk County, $159 million for Middlesex County, and tens of millions of dollars in savings for other surrounding counties in eastern Massachusetts and bordering states.

"In this study, we focused only on the City of Boston's climate action plan, but it's important to note that Boston's actions will not occur in a vacuum," Raifman says. "Many cities across the region are pursuing similar climate goals. The sum may be different from the parts."

More information: Matthew Raifman et al. *Environ. Res. Lett.* 2020 in press doi.org/10.1088/1748-9326/ab842b

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