Study links adoption of electric vehicles to less air pollution and improved health

February 2 2023

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Electric vehicles are widely hailed as a key way to mitigate climate change through reduced emissions, but research on the dual benefits of

reduced air pollution and improved health has been largely hypothetical.

A team of researchers from the Keck School of Medicine of USC have now begun to document the actual impact of electric vehicle adoption in the first study to use real-world data to link electric cars, air pollution and health. Leveraging publicly available datasets, the researchers analyzed a "natural experiment" occurring in California as residents in the state rapidly transitioned to electric cars, or light-duty zero emissions vehicles (ZEVs). The results were just published in the journal *Science of the Total Environment*.

The team compared data on total ZEV registration, air pollution levels and asthma-related emergency room visits across the state between 2013 to 2019. As ZEV adoption increased within a given zip code, local air pollution levels and emergency room visits dropped.

"When we think about the actions related to climate change, often it's on a global level," said Erika Garcia, Ph.D., MPH, an assistant professor of population and public health sciences at the Keck School of Medicine and the study's lead author. "But the idea that changes being made at the local level can improve the health of your own community could be a powerful message to the public and to policy makers."

The researchers also found that while total ZEVs increased over time, adoption was considerably slower in low-resource zip codes—what the researchers refer to as the "adoption gap." That disparity points to an opportunity to restore environmental justice in communities that are disproportionately affected by pollution and related health problems.

"The impacts of climate change on health can be challenging to talk about because they can feel very scary," said Sandrah Eckel, Ph.D., an associate professor of population and public health sciences at the Keck School of Medicine and the study's senior author. "We're excited about

shifting the conversation towards climate change mitigation and adaptation, and these results suggest that transitioning to ZEVs is a key piece of that."

Benefits for health and the climate

To study the effects of electric vehicle adoption, the research team analyzed and compared four different datasets. First, they obtained data on ZEVs (which includes battery electric, plug-in hybrid, and hydrogen fuel cell cars) from the California Department of Motor Vehicles and tabulated the total number registered in each zip code for every year between 2013 and 2019.

They also obtained data from U.S. Environmental Protection Agency air monitoring sites on levels of nitrogen dioxide (NO_2), an air pollutant related to traffic, and zip code level asthma-related visits to the emergency room. Asthma is one of the health concerns long linked with air pollutants such as NO_2, which can also cause and exacerbate other respiratory diseases, as well as problems with the heart, brain and other organ systems.

Finally, the researchers calculated the percentage of adults in each zip code who held bachelor's degrees. Educational attainment levels are frequently used as an indicator of a neighborhood's socioeconomic status.

At the zip code level, for every additional 20 ZEVs per 1,000 people, there was a 3.2% drop in the rate of asthma-related emergency visits and a small suggestive reduction in NO_2 levels. On average across zip codes in the state, ZEVs increased from 1.4 to 14.6 per 1,000 people between 2013 and 2019. ZEV adoption was significantly lower in zip codes with lower levels of educational attainment.

For example, a zip code with 17% of the population having a bachelor's degree had, on average, an annual increase of 0.70 ZEVs per 1,000 people compared to an annual increase of 3.6 ZEVs per 1,000 people for a zip code with 47% of the population having a bachelor's degree.

Past research has shown that underserved communities, such as lower-income neighborhoods, tend to face worse pollution and associated respiratory problems than more affluent areas. If ZEVs replace gas-powered cars in those neighborhoods, they could stand to benefit substantially.

"Should continuing research support our findings, we want to make sure that those communities that are overburdened with the traffic-related air pollution are truly benefiting from this climate mitigation effort," Garcia said.

More to learn

While climate change is a massive health threat, mitigating it offers a massive public health opportunity, Eckel said. As one of the first studies to quantify the real-world environmental and health benefits of ZEVs, the research can help demonstrate the power of this mitigation measure, including possibly reduced health care utilization and expenditures.

The findings are promising, Garcia said, but many questions remain. Future studies should consider additional impacts of ZEVs, including emissions related to brake and tire wear, mining of materials for their manufacture, and disposal of old cars. The researchers also hope to study additional types of pollutants and other classes of vehicles, in addition to conducting a follow-up study of the effects of the ever-growing share of ZEVs in the state.

Moving forward, transitioning to ZEVs is just one part of the solution,

Eckel said. Shifting to public transport and active transport, including walking and biking, are other key ways to boost environmental and public health.

More information: Erika Garcia et al, California's early transition to electric vehicles: Observed health and air quality co-benefits, *Science of The Total Environment* (2023). DOI: 10.1016/j.scitotenv.2023.161761

Provided by Keck School of Medicine of USC