Electric vehicle adoption improves air quality and climate outlook

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An owner of an electric vehicle charges the car's battery. Credit: Karlis Dambrans

If you have ever wondered how much electric vehicle (EV) adoption actually matters for the environment, a new study provides evidence that making this switch would improve overall air quality and lower carbon emissions.

The Northwestern University study quantified the differences in air pollution generated from battery-powered electric vehicles versus internal combustion engines. The researchers found that even when their electricity is generated from combustion sources, electric vehicles have a net positive impact on air quality and climate change.

"In contrast to many of the scary climate change impact stories we read in the news, this work is about solutions," said Northwestern's Daniel Horton, senior author of the study. "We know that climate change is happening, so what can we do about it? One technologically available solution is to electrify our transportation system. We find that EV adoptions reduces net carbon emissions and has the added benefit of reducing air pollutants, thereby improving public health."

The research published Friday, April 5 in the journal *Atmospheric Environment*. Horton is an assistant professor of Earth and planetary sciences in Northwestern's Weinberg College of Arts and Sciences. Jordan Schnell, a postdoctoral research fellow with the Ubben Program for Climate and Carbon Science in the Institute for Sustainability and Energy at Northwestern, was the paper's first author.

To quantify the differences between the two types of vehicles, the researchers used an emissions remapping algorithm and air quality model simulations. They used these methods to closely examine two pollutants related to automobiles and power emissions: ozone and particulate matter. Both are main components of smog and can trigger a variety of health problems, such as asthma, emphysema and chronic bronchitis.

To fully account for the complexity of changes to air pollution chemistry, the researchers took multiple variables into consideration:

- Potential electric vehicles adoption rates
- Generation of electric vehicle power supply, including our current combustion-dominant mix, combustion-only sources and enhanced emission-free renewables
- Geographical locations
- Seasons and times of day

Ozone levels decreased across the board in simulations of warmer weather months. In the wintertime, however, ozone levels increase slightly but are already much lower compared to summer due to a chemical reaction that occurs differently during times of lesser winter sunlight.

"Across scenarios, we found the more cars that transitioned to electric power, the better for summertime ozone levels," Schnell said. "No matter how the power is generated, the more combustion cars you take off the road, the better the ozone quality."

Particulate matter, which is also called "haze," decreased in the wintertime but showed greater variation based on location and how the power was generated. Locations with more coal-fired power in their energy mix, for example, experienced an increase in haze during the summer. Locations with clean energy sources, however, saw drastic reductions in human-caused haze.

"We found that in the Midwest, the increased power demands of EV charging in our current energy mix could cause slight increases in summer particulate matter due to the reliance on coal-fired power generation," Schnell said. "However, if we transition more of the Midwest's power generation to renewables, particulate matter pollution is substantially reduced. In the Pacific Northwester or Northeast, where there is already more clean power available, EV adoption—even with the current energy mix—will decrease particulate matter pollution."

More information: Jordan L. Schnell et al, Air quality impacts from the electrification of light-duty passenger vehicles in the United States, *Atmospheric Environment* (2019). DOI: 10.1016/j.atmosenv.2019.04.003

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