

# Environmental impact of electric vehicles in China? It depends on how they are charged

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Traffic and smog in Beijing. Credit: Harvard John A. Paulson School of Engineering and Applied Sciences

Electric vehicles play a key role in China's plan to improve air quality and reduce CO<sub>2</sub> emissions but, with the majority of China's electricity still coming from coal-fired power plants, many question just how effective this strategy will be.

Now, researchers from Harvard University and Tsinghua University in Beijing found that private [electric vehicles](#) in China can have a positive effect on CO<sub>2</sub> reduction if owners can be incentivized to slowly charge vehicles during off-peak hours, allowing for more effective use of wind-generated [power](#). Quickly charging vehicles in the higher energy "fast mode", on the other hand, can be counterproductive.

Meanwhile, buses and taxis in China make a significant contribution to NOX emissions, a major precursor for [air pollution](#). The team determined that electrifying the bus and taxi fleet offers the most effective option for improving air quality.

The research is published in *Nature Energy*.

"This research offers a more nuanced strategy for reducing CO<sub>2</sub> emissions and improving air quality in China," said Michael B. McElroy, the Gilbert Butler Professor of Environmental Studies at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) and the Department of Earth and Planetary Sciences and co-author of the research.

"It is critically important that electric [vehicle](#) charging is managed properly to maximize the benefits of renewables," said Xinyu Chen, Research Associate in Environmental Science and Engineering at SEAS and co-author of the study.

The researchers used real-time power demand data and driving patterns for Beijing and its suburbs to develop a comprehensive model of the energy system. They found that how electric vehicles are charged—whether in the low-energy slow mode or high-energy fast mode—plays a significant role in the integration of wind energy. Typically, vehicle charging in the 30-minutes or less fast mode occurs during hours of peak power demand. As a result, peak power demand is

increased, triggering additional coal generators to come online. With these generators operational at night, the opportunity to take advantage of available wind power is reduced.

"If people were incentivized to wait until evening and charge their vehicles in the slow-charge mode, which takes hours, the power load could take advantage of wind energy available during off-peak hours," said Chris P. Nielsen, Executive Director of the Harvard China Project and co-author of the study.

In terms of lowering air pollution, the researchers found that the gas- or diesel-fueled fleet of public vehicles—about 30,000 buses and 66,000 taxis—is responsible for nearly 20 percent of total NOX emissions, equivalent to the contribution from 8.2 million private vehicles. Electrifying the fleet of buses and taxis in Beijing would significantly reduce total NOX emissions and increase [air quality](#).

"Electrifying the public fleet and introducing incentives to charge personal electric vehicles at off-peak times would be the most effective strategy to reduce NOX and CO<sub>2</sub> emissions in Beijing," said McElroy. "This strategy could also be applied to cities across the world that have a significant source of electricity from coal."

**More information:** Xinyu Chen et al, Impacts of fleet types and charging modes for electric vehicles on emissions under different penetrations of wind power, *Nature Energy* (2018). [DOI: 10.1038/s41560-018-0133-0](https://doi.org/10.1038/s41560-018-0133-0)

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