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How much CO2 do EVs cut? Size matters

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Replacing gas-powered pickup trucks with electric alternatives prevents more carbon dioxide emissions than electrifying smaller cars, according to a new study from the University of Michigan and the Ford Motor Co.

The study, which was published earlier this year in *Environmental Research Letters*, analyzed life cycle greenhouse gas emissions for sedans, sports utility vehicles and pickup trucks. The researchers found that electrifying larger vehicles would lead to greater reductions in absolute emissions.

The research is "the first comprehensive analysis of the life cycle greenhouse gas emissions for comparing ICEVs to EV pickups," said Gregory Keoleian, the director of the University of Michigan's Center for Sustainable Systems and senior author of the study, referring to internal combustion engine vehicles and electric vehicles.

"Previous studies have focused on comparing battery electric vehicle sedans and SUVs to their internal combustion engine or hybrid counterparts," Keoleian said in an email to E&E News, "so previous comparisons across vehicle classes have been limited."

Battery electric sedans emitted 45 tons less CO2 over their lifetimes than their gas-powered counterparts, the study said — the equivalent of about 100 barrels of oil. Battery electric SUVs emitted 56 tons — or 130 barrels' worth — less, while battery electric pickup trucks emitted 74 tons, or 170 barrels, less.

The results could help guide assessments of progress toward goals for emissions reduction, Keoleian said.

To understand different vehicles' emissions over their full life cycles, the researchers considered both vehicle manufacturing and end use. For each class of car, battery electric vehicles generated more emissions during manufacturing than their internal combustion engine or hybrid electric counterparts, "primarily due to the Li-ion battery," the study said.

In their calculation of end-use emissions, the researchers accounted for differences in driving patterns that could affect the way vehicles performed.

Gas-powered cars had greater fuel economies on highways compared to urban settings, the study said, while both hybrid and battery electric vehicles were more efficient for city driving. But even assuming 100 percent highway driving, battery electric vehicles produced the lowest emissions.

The researchers also considered regional factors that could influence emissions. They found a "substantial variation in emissions based on where and when a vehicle is charged and operated, due to the impact of ambient temperature on fuel economy and the spatiotemporal variability in grid carbon intensity across the United States," the study said.

Battery electric vehicles were the lowest emitters under most of the 3,100 U.S. counties the researchers analyzed. Across all three vehicle classes, battery electric vehicles generated lower emissions than hybrid or gas-powered cars in over 2,900 counties. Gas-powered cars did not have the lowest emissions in any of the counties.

Across the three vehicle classes, battery electric vehicles generated almost 65 percent less emissions over their entire life cycles than gas-powered vehicles.

"We clearly demonstrate the benefits of BEVs to lower greenhouse gas emissions," Keoleian said. "The bottom line for climate change is that we need to replace ICEVs everywhere across the country with BEVs as quickly as possible."

The study also found that switching a gas-powered to a battery electric vehicle cut absolute emissions more drastically as vehicle size increased, due to differences in fuel consumption.

Battery electric sedans saved 260 grams of CO_2 per mile compared to gas-powered sedans, battery electric SUVs saved about 280 grams per mile, and battery electric pickups saved almost 370 grams per mile, according to the study.

Martin Günsberg, a spokesperson for Ford, said the analysis "confirms that the transition to BEVs, particularly in the light-duty truck segment, can help reduce total greenhouse gas emissions from the transport sector."

Despite the potential to reduce emissions by switching to electric vehicles “electrification alone is insufficient to decarbonize the transportation sector,” the study said. The researchers pointed to other measures for slashing emissions, like reducing travel demand and downsizing vehicle sizes.

Another recent study from the Institute for Transportation and Development Policy, an urban transportation nonprofit, and the University of California, Davis, found that worldwide, aggressive adoption of electric vehicles alone would not reduce transportation sector emissions enough to meet midcentury Paris Agreement goals (*Energywire*, Feb. 16, 2022).

But when electric vehicle adoption was paired with urban growth planning to reduce sprawl, emissions could be brought well below those targets, that study found.

The study was supported by Ford through an ongoing research partnership with the University of Michigan.