

## FUTURE OF TRANSPORTATION

# E.V.s Start With a Bigger Carbon Footprint. But That Doesn't Last.

The manufacturing and disposal of electric vehicles result in more greenhouse gases than nonelectric models, but that difference will eventually disappear altogether.



*Studies have found that though it's true that the production of a B.E.V. causes more pollution than a gasoline-powered counterpart, that greenhouse gas emission difference is erased as the vehicle is driven. Matt Williams*

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*This article is part of our series on the [Future of Transportation](#), which is exploring innovations and challenges that affect how we move about the world.*

In the 19th century, major cities faced their own emissions problem: horse manure.

With horse-drawn carriages clogging major thoroughfares, cities were burdened with noxious, smelly manure that drew flies and spread disease.

The issue started to resolve itself as internal combustion engine cars grew in popularity at the beginning of the 20th century. Of course, that meant horses, slowly but inexorably, were replaced by vehicles emitting greenhouse gases.

Now, as battery electric vehicles, or B.E.V.s — marketed as a more environmentally friendly vehicular option — replace internal combustion engines, some skeptics are pointing out that they actually have a larger carbon footprint than nonelectric vehicles. That's due to the manufacturing and disposal of B.E.V.s — specifically their batteries — as well as a reliance on coal to create the electricity that powers them.

To determine the environmental costs of the trade-off, trade organizations and universities have conducted life cycle analyses, or L.C.A.s: comparisons between the amount of greenhouse gases created from the production, use and disposal of a B.E.V. and the gases from a gasoline-powered vehicle of a similar size.

The good news: Studies have found that, though it's true that the production of a B.E.V. causes more pollution than a gasoline-powered counterpart, this greenhouse-gas emission difference is erased as the vehicle is driven.

And erasing the difference does not appear to take very long. In a [study](#) conducted by the University of Michigan (with a grant from the Ford Motor Company), the pollution equation evens out between 1.4 to 1.5 years for sedans, 1.6 to 1.9 years for S.U.V.s and about 1.6 years for pickup trucks, based on the average number of vehicle miles traveled in the United States.

The study found that, on average, emissions from B.E.V. sedans were 35 percent of the emissions from an internal-combustion sedan. Electric S.U.V.s produced 37 percent of the emissions of a gasoline-powered counterpart, and a B.E.V. pickup created 34 percent of the emissions of an internal combustion model. (Because gasoline-powered pickups consume more fuel than smaller vehicles, switching to a battery electric pickup results in a greater reduction in emissions.)

These results vary, based on how much greenhouse gas is created through the production of the electricity needed to charge a battery. The greater the use of renewable sources — such as wind, solar, nuclear and hydropower — the greater the reduction in emissions.

Of the more than 3,000 counties in the United States, 78 had increased overall emissions from electric sedans than from internal combustion vehicles — a result attributable to the fact that, in these counties, most of the electricity was generated from coal, said Greg Keoleian, director of the Center for Sustainable Systems at the University of Michigan and lead author of the study.

One of the main critiques of B.E.V.s has centered on a reliance on coal to produce the electricity needed to power these vehicles, along with the emissions produced by battery production and the shortness of battery life.

For example, a [study](#) conducted at the Leibniz Institute for Economic Research at the University of Munich, said that a Mercedes C220 diesel creates less greenhouse gas emissions than does a Tesla Model 3. Michael Kelly, professor emeritus of engineering at Cambridge University, [argued](#) that the need to charge electric vehicles would overload the electric grid and could lead to power cuts in Britain. He also believes the world does not have enough raw materials to make the large quantities of batteries needed.

Neither of those statements is accurate, according to Auke Hoekstra, director of energy transition research at the Eindhoven University of Technology. In a [paper](#) published in 2020, Mr. Hoekstra writes that batteries will most likely last more than 500,000 kilometers, or 310,000 miles; that research shows gasoline and diesel pollute more than previously thought; and that the energy needed to create batteries has already declined while electricity production from renewable sources is growing.

Mr. Keoleian said he expects that electric vehicle emissions will improve, even in those U.S. counties that rely on coal to create power for the vehicles. "In the future, B.E.V. emissions will

decrease due to the retirement of coal plants and the increase in renewable energy sources," he said. "Our message is that we need to accelerate the transition to battery electric vehicles."

Multiple studies have supported the view that electric vehicles are already the more environmentally friendly choice — and will only become more so as technology progresses.

"The Ford-financed study is 100 percent correct," Mr. Hoekstra said. "All studies agree that electric vehicles save between 50 to 70 percent CO<sub>2</sub> equivalents and that the time needed to recoup the additional emissions caused by battery production is one to two years. The more you drive, the faster you'll recoup."

This January, another [study](#), conducted by Ricardo PLC, a nonprofit think tank focusing on transit and fuel, found similar results. In 200,000 miles of driving, a typical internal combustion vehicle would emit 66 tons of greenhouse gas emissions in the United States. A battery electric vehicle would emit 39 tons over that same distance. And within 19,000 miles, the higher emissions caused by battery manufacturing would be offset by lower emissions from driving an electric vehicle.

There are other challenges that still need to be met, including reducing the amount of materials necessary to produce batteries and finding other sources for components, "but there are no showstoppers," said Nikolas Hill, head of vehicle technologies and fuels for Ricardo Energy & Environment, based in Oxford, England.

Even though the United States should experience significant greenhouse gas emissions reductions because drivers travel greater distances, countries in Europe have also seen benefits.

According to an L.C.A. [study](#) published in 2020, prepared by Ricardo for Britain's Department for Transport, electric vehicles saved an estimated 65 percent in emissions compared with a similar internal combustion vehicle. With expected improvements in battery manufacturing and the further decarbonization of the British electrical grid, B.E.V.s are predicted to generate a 76 percent reduction in greenhouse gases by 2030 and a potential 81 percent decrease by 2050.

By 2050, it's possible that emissions from the production phase of an electric vehicle and of a conventional internal combustion model will be similar, the report stated.

In an L.C.A. [study](#) conducted by Volkswagen, the company found that driving its ID.3, a small B.E.V. not sold in the United States, more than 120,000 miles in Europe would create about a 26 percent decrease in greenhouse gas emissions compared with a Golf model of a similar size.

And a study conducted in India by RMI, a nonprofit organization that works to increase sustainable energy systems, found that the country still showed net gains for B.E.V.s even though it generates 75 percent of its electricity from coal.

"The superior efficiency of B.E.V.s is so significant that operational savings even in carbon-intensive contexts position B.E.V.s as a net win," said Clay Stranger, managing director of the institute's transportation program.

All of the criticisms of B.E.V.s will soon be a thing of the past, said Mr. Hoekstra, as battery production becomes cleaner and begins to last the lifetime of a vehicle, while electricity generation moves away from coal.

"There are no countries in the world where B.E.V.s pollute more than internal combustion vehicles," he said. "And when it comes to the U.S., there's no way in hell that the current electrical generating mix will remain as polluting as it is today."