

For decades, EV skeptics and oil companies have argued that EVs don't really pollute less than ICEVs (internal combustion engine vehicles) - they just transfer the pollution from the tailpipe to the electrical power plant. Independent researchers have repeatedly debunked their argument, but the EV critics control more media, and they shout louder.

More recently petroleum industry apologists have seized on the fact that manufacturing EVs, especially their batteries, is more carbon-intensive than manufacturing ICEVs. That *is* a fact.

So is it true? Do EVs really pollute more than ICEVs?

In the long run, no.

Recent research has carried out life cycle analyses (LCAs) on ICEVs and EVs, comparing vehicles of similar size and use. They've found that while producing an EV does emit more pollution than manufacturing an ICEV, the balance, especially for CO₂, swings the other way as the vehicle is used.

A University of Michigan study found that EVs' net greenhouse gas (GHG) emissions break even with ICEVs' at 1.4 to 1.5 years for passenger cars, 1.6 to 1.9 years for SUVs, and around 1.6 years for pickup trucks. From then on, EVs are cleaner.

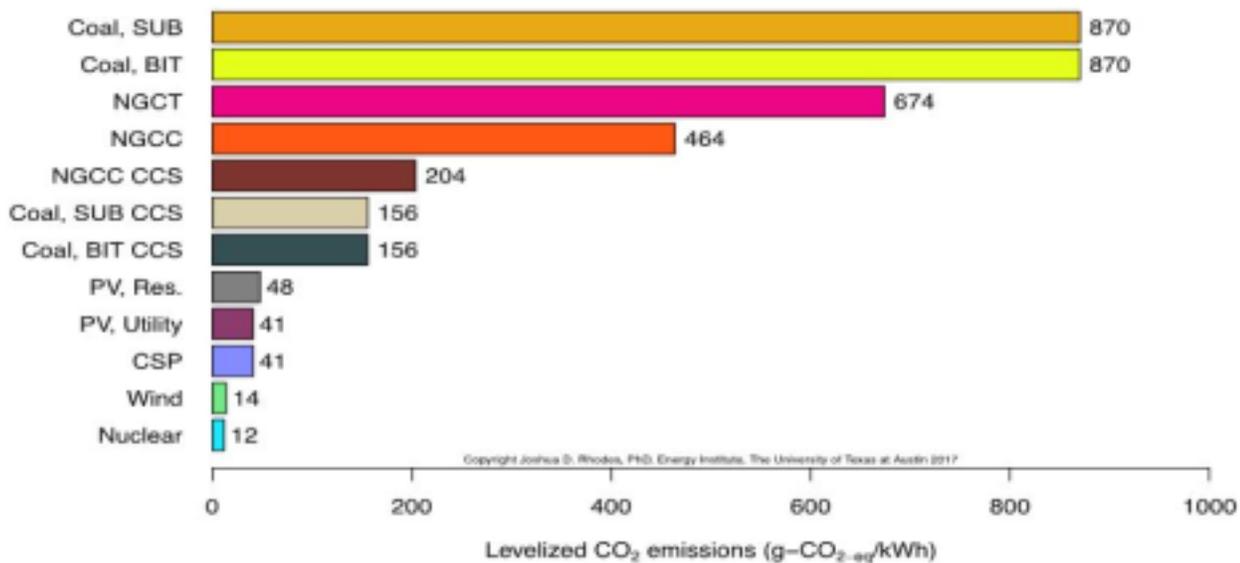
Across the board, full life cycle GHG emissions from pure EVs (that is, battery EVs or BEVs) were about 1/3 of those from ICEVs. More precisely, emissions were 65% less for passenger cars, 63% less for SUVs, and 66% less for pickups.

By over-estimating the percentage of US coal-generated, high-carbon electricity, EV opponents can make EVs look dirtier than they really are. The truth is that of the 3,142 counties and similar political regions in the US, only 78 of them - 2.5% - generate enough of their electricity from coal to make EVs charged there dirtier than ICEVs. And if you live in one of those counties, you can make your EV emission free by charging it from solar panels on your own roof. You can't do that anywhere with an ICEV.

That said, it *does* make a difference how the electricity for EVs is generated. When coal burns, most of the energy released is from carbon. Theoretically, natural gas has about 42% less carbon. In practice, once you factor in the carbon intensity of building different types of power plants and sourcing input, distributing that carbon intensity over the plants' service lifetimes, carbon emissions from natural gas power plants are around 23% less than from coal plants.

But natural gas's carbon reduction is nothing by comparison with solar, hydroelectric, wind, and nuclear energy. Solar energy (PV) emits 95% less CO₂ than coal, hydroelectric 97% less, wind 98% less, and nuclear 99% less. Check out the chart from the University of Texas's Energy Institute on the next page.

Estimated levelized CO₂-eq emissions



Estimated Lifetime Levelized Carbon Intensities of 12 Different Power Plants (source: University of Texas)

SUB = sub-bituminous (dirty) coal
 BIT = bituminous coal
 NGCT = natural gas combustion turbine
 NGCC = natural gas combined cycle
 CCS = 90% carbon capture and sequestration
 PV = solar photovoltaic
 CSP = concentrated solar power
 Wind = onshore wind

In January 2022, a Ricardo Strategy Consulting study chimed with the University of Michigan research. RSC found that over a 200,000 mile vehicle lifetime, a typical EV would produce 41% less GHG than an equivalent ICEV (39 tons vs 66 tons). RSC concluded that the break-even point where the EV surpassed the ICEV for GHG emissions was less than 19,000 miles.

In other countries with different electricity mixes, the GHG reductions vary. For example, a 2020 UK study by the same group showed that EVs had 65% lower emissions. RSC also predicted that as battery manufacturing gets more efficient and the UK grid gets cleaner, by 2030 the EV GHG bonus would be 76%; by 2050, 81%.

In Germany, Volkswagen calculated that 200,000 km in a VW ID.3 EV instead of a Golf ICEV would reduce GHG emissions by 26%. And in India, where 75% of the electricity comes from coal, another study showed that EVs *still* would have lower net GHG emissions.

Sources:

1. Eric Taub, EVs Start With a Bigger Carbon Footprint, But That Doesn't Last, *New York Times* 2022/10/19. <https://www.nytimes.com/2022/10/19/business/electric-vehicles-carbon-footprint-batteries.html>
2. BD Hong & ER Slatick, Carbon Dioxide Emission Factors for Coal, *Quarterly Coal Report* 1991/01-04, US Department of Energy. https://www.eia.gov/coal/production/quarterly/co2_article/co2.html
3. Natural Gas and the Environment, US Energy Information Administration. <https://www.eia.gov/energyexplained/natural-gas/natural-gas-and-the-environment.php>
4. Josh Rhodes, Nuclear and Wind Power Estimated to Have Lowest Levelized CO₂ Emissions, University of Texas. <https://energy.utexas.edu/news/nuclear-and-wind-power-estimated-have-lowest-levelized-co2-emissions>
5. Carbon Emissions from Hydropower Reservoirs: Facts and Myths, International Hydropower Association. <https://www.hydropower.org/blog/carbon-emissions-from-hydropower-reservoirs-facts-and-myths>

The Shrinking EV Carbon Footprint • http://evdl.org/docs/ev_carbon_footprint.pdf • Release 1.0 2022/10/22
 Reuse rights: Creative Commons 3.0 BY/NC/SA US <https://creativecommons.org/licenses/by-nc-sa/3.0/us/>
 See also: <http://evdl.org/docs/powerplant.pdf>