Updates to data and methods – Carboncounter.com 2021

Vehicle data and selection

Vehicle data

Vehicle data has been updated to reflect 2021 models. Vehicle data shown is drawn from fueleconomy.gov, which publishes official fuel economy certifications, with additional data collected from manufacturers' websites (prices, horsepower, exact curb weight, battery capacity for PHEVs/BEVs).

Vehicle coverage

Nearly all 2021 models available on the market are included in carboncounter.com, apart from a small number of models (<10) for which the full data set could not be obtained. 2020 models that have not been updated for 2021 as of January 5, 2021, and which have not been officially discontinued, are also included.

Powertrain options are reflected for each model, corresponding to different trim levels. Powertrain options include vehicle technology (such as hybridization), drivetrain (2WD/AWD), and engine (size/performance). For those models that have a large number of options, a few are missing for some models (<10%). The model's base trim is always reflected.

For each model-powertrain combination, the most affordable and lightest configuration is used. This means that the cost and weight of additional accessories and options beyond model and powertrain configurations are not considered; these are also not considered in the official fuel economy certification.

Vehicles shown in default setting of carboncounter.com

All vehicles are accessible through the search function (approx. 1000). 333 of these are shown in the scatterplot by default.

For each vehicle model and technology type (conventional, hybrid, electric, etc), the most fuel-efficient trim (often, but not always, the base trim) is shown in the set of 333 vehicles in the scatterplot default setting. Vehicles with a manufacturer suggested retail price (MSRP) of greater than $57,000 (conventional and hybrids), $66,000 (plug-in hybrids), and $70,000 (battery electric vehicles) are not shown in the default scatterplot. The MSRP cutoffs constrain the range of the x-axis for plot readability. The axis is extended automatically when users search for and select more expensive vehicles.

When many powertrain options with significantly different fuel economy ratings exist for a single model, additional trim levels are shown in the default plot if they have a lower fuel economy rating than other trims shown (they are less efficient) by at least 4 MPG (and they do not exceed the upper bound prices noted in the previous paragraph). These additional trim levels are only shown for vehicles with an MSRP above $35,000 to avoid overcrowding of the default scatterplot.

Changes in default background conditions

The default emissions intensity for electricity production has been updated from 623 gCO2eq/kWh to 450 gCO2eq/kWh based on eGRID data (https://www.epa.gov/egrid/summary-data).

The default average annual travel distance was updated from 12,000 miles/year to 13,000 miles/year, based on https://www.bts.gov/content/us-vehicle-miles.

The default hydrogen price was updated from $12/kg to $16/kg to reflect current average prices in California (the state that presently represents the largest market for fuel cell vehicles), based on https://ww2.energy.ca.gov/2019publications/CEC-600-2019-039/CEC-600-2019-039.pdf.

Vehicle and liquid fuel production emissions

Emissions inventories for the production of vehicles and fuels were updated to GREET 2019 (from GREET 2014). In addition, updated sources were used to estimate emissions from the production of lithium-ion batteries (see list below), and the default emissions changed from 52 $kgCO_2eq/kWh$ to 100 $kgCO_2eq/kWh$. The user now has the option to select among three different levels of emission intensity for battery production, reflecting the reported range.

The sources used for the updated range and default estimate were:

- The GREET 2019 inventories, indicating around 70-90 $kgCO_2eq/kWh$ depending on battery capacity, specific chemistry, and background conditions.
- Ellingsen, Hung, and Strømman (2017). Identifying key assumptions and differences in life cycle assessment studies of lithium-ion traction batteries with focus on greenhouse gas emissions. *Transportation Research Part D: Transport and Environment.*
- Kim et al. (2016). Cradle-to-Gate Emissions from a Commercial Electric Vehicle Li-Ion Battery: A Comparative Analysis. *Environmental Science & Technology*.

Depreciation

In the previous version, the MSRP was added to total cost of ownership, assuming that the vehicle stays in primary ownership until its end of life (that is, until it has lost all its value). Now, the user has an option to set the total vehicle lifetime (which affects emissions per distance and per unit time) and the duration of ownership. After the duration of ownership ends, the remaining vehicle value after depreciation is subtracted from the total costs of ownership.

Premium gasoline

A price premium of $0.6/gal has been added for vehicles that require premium gasoline according to the manufacturer's specifications.

Tax refunds

Federal tax refunds have been adjusted for vehicles of manufacturers for which federal refunds have phased out (Tesla, Chevrolet).

The option of including additional refunds offered by specific states is now available. Data was obtained from https://evcharging.enelx.com/resources/federal-and-state-electric-vehicle-incentives.

Taxes/title/fees

An option has been added to consider sales taxes, title, and registration fees for a given, user-selected state. Previously, these taxes and fees had been excluded. Car sales taxes by state are based on https://www.findthebestcarprice.com/car-sales-tax-by-state/. Title and fees by state are based on https://www.ncsl.org/Portals/1/Documents/transportation/Motor_Vehicle_Registration_Fees_18014.pdf#

page=5 and https://www.compare.com/auto-insurance/coverage/vehicle-costs. Additional fees for electric vehicles are based on https://www.ncsl.org/research/energy/new-fees-on-hybrid-and-electric-vehicles.aspx.

PHEV utility factor

Previously, the utility factor was set by the user, with a default value of 60%. Now, the default utility factor is based on the corresponding EPA estimate. This estimate is different for each vehicle model and depends on the vehicle's battery capacity and fuel economy in charge depleting mode. The utility factor is reported separately for city and highway driving, and the combined estimate in carboncounter.com 2021 accounts for the city/highway driving share indicated by the user. The user can adjust the utility factor (5 levels) relative to the default, EPA-based value.