

Formula Worksheet - Estimating Driving CO2 Emissions Grams Per Mile Driven for Electric Vehicles, e.g. E-scooters, E-bikes and Electric Cars

Note: For most consumer electric cars, the Environmental Protection Agency has already done these computations and the result can be looked up using:

U.S. Environmental Protection Agency. 2018a. Find and Compare Cars (Fuel economy and environmental impacts by year, make and model, database).

<https://www.fueleconomy.gov/>

$$EV_e \frac{CO_2 \text{ grams}}{\text{mile}} = \frac{\alpha CO_{2e} \text{ metric ton} \times \frac{1000000 \text{ grams}}{\text{metric ton}}}{\beta \text{ mega watt hour} \times \frac{1000000 \text{ watt hour}}{1 \text{ mega watt hour}}} \times \frac{\delta \text{ watt hour EV battery capacity}}{1 - \gamma \text{ transmission loss \%}} = \frac{\alpha \times \delta}{\beta \times (1 - \gamma) \times \epsilon} \frac{CO_2 \text{ grams}}{\text{mile}}$$

where:

EV_e = electric vehicle emissions.

CO_{2e} = CO2 emissions.

α = metric tons of CO2 emitted by all electric power plant types in your state.

Data source: U.S. Energy Information Administration. 2018a. FAQ: How much carbon dioxide is produced per kilowatt hour of U.S. electricity generation? U.S. Electric Power

Industry Estimated Emissions by State. File: emission annual.xls.

Accessed November 26, 2018. <https://www.eia.gov/tools/faqs/faq.php?id=74&t=11>

β = metric tons of CO2 emitted by all electric power plant types in your state.

Data source: U.S. Energy Information Administration. 2018b. FAQ: How much carbon dioxide is produced per kilowatt hour of U.S. electricity generation? Net Generation by State

by Type of Producer by Energy Source. File: annual_generation.xls. Accessed November 26, 2018. <https://www.eia.gov/tools/faqs/faq.php?id=74&t=11>

γ = average percent transmission line power loss for your state.

Data source: Wirfs-Brock, J. Nov. 6, 2015. Lost In Transmission: How Much Electricity Disappears Between A Power Plant And Your Plug? Inside Energy Blog.

<http://insideenergy.org/2015/11/06/lost-in-transmission-how-much-electricity-disappears-between-a-power-plant-and-your-plug/>

δ = watt hour storage capacity of your electric vehicle. Data source: Your manufacturer's specification sheet.

ϵ = the range of your electric vehicle. Data source: Your manufacturer's specification sheet.

Example computation for a Segway ES4 scooter used in Salt Lake City, Utah (*See main paper*):

$$\frac{31133928 \cdot 374}{28244970 \cdot (1 - 0.043) \cdot 28} \frac{CO_2 \text{ grams}}{\text{mile}}$$

$$\frac{15.38489129 \text{ } CO_2 \text{ grams}}{\text{mile}}$$

(1)

Kurt A. Fisher November 28, 2018 "Dockless E-scooter CO2 Emissions: An Early Analysis for Salt Lake City"