SOLARPONICS
GO SOLAR • GO LOCAL • GO TRUSTED

HOW TO UNDERSTAND ELECTRIC CAR FUEL EFFICIENCY and FUEL CONSUMPTION (or, what the heck is MPGe).

Solarponics Energy Solutions
4700 El Camino Real, Atascadero, CA 93422
(805) 466-5595
www.solarponics.com
frank@solarponics.com

Ask anyone what kind of gas mileage their car gets, and they will probably know right off the top of their head. We're obsessed with the gas mileage of our cars, in large part because of the high cost of gasoline. Gas mileage performance ranks as a top decision when deciding to buy a new car.

But how do we determine the fuel costs of an electric vehicle? How do we really know the cost comparison to drive an electric vehicle 100 miles, vs. driving a gasoline vehicle 100 miles? What does MPGe mean? How are the stickers calculating annual fuel cost? How do the manufacturers calculate my five-year fuel savings over a new gasoline vehicle?

The first thing I should point out is that the window sticker of an EV makes several assumptions. First, that energy rates are 12¢ per kWh, that gasoline costs $4.00 per gallon, and that a new fuel efficient gasoline vehicle gets 22 miles per gallon. I'll explain the window sticker using these assumptions, and then compare that to real-life values.

The electric vehicle MPGe, or Miles Per Gallon equivalent, represents the number of miles the vehicle can travel using the same energy content as gasoline. My EV window sticker states an MPGe of 99. This is also the maximum distance this vehicle can travel on a full charge.

Electric vehicles use kWh (the measure of energy from electricity), not MPG to state their energy use. My EV window sticker says it uses 34kWh per 100 miles driven. We'll need to convert the amount of energy in a gallon of gasoline into kWh of energy. I will skip all of the formulas, most of which I don't understand anyway, and just report that the MPGe metric introduced in 2010 by the EPA is based on their formula in which 33.7 kWh of electricity is equivalent to one gallon of gasoline, rounded up to 34kWh.[1]

The window sticker compares the EV to a gasoline vehicle that gets 22 MPG. For this vehicle to travel 100 miles, it will use 4.5 gallons of gas. If a gallon of gas is equal to 34kWh of energy, and our gasoline vehicle can drive 100 miles using 4.5 gallons of gas, then our gasoline vehicle uses 85 kWh per 100 miles driven. At $4.00 per gallon, our gasoline vehicle costs $18 per 100 miles driven.

Electric vehicle gets 100 miles per 34 kWh
Gasoline vehicle gets 100 miles per 85kWh

Our gasoline vehicle uses 2.5 times more kWh of energy to travel the same distance as the

[1] New Fuel Economy and Environment Labels for a New Generation of Vehicles" (PDF). *epa.gov*. Retrieved 2 August 2015. line feed character in |title= at position 33 (help)

EV. But, the cost of the fuel that creates the kWh of energy is quite different, and as those costs change, so will the cost of operating each vehicle.

> Electric energy costs 12¢ per kWh (34kWh x .12 = $4.08 per 100 miles)
> At 15,000 miles per year, annual fuel cost is $612
> 5 year fuel costs = $3,060
>
> Gasoline vehicle gets 100 miles per 85kWh
> Gasoline costs $4.00 per gallon (4.5 gallons x $4.00 per gallon = $18.00 per 100 mi)
> At 15,000 miles per year, annual fuel cost is $2,700
> 5 year fuel costs = $13,500

Our gasoline vehicle costs over four times more for fuel, $13,500, or $10,440 more over five years ($13,500 - $3,060 = $ 10,440).

But gas is not $4.00 per gallon, energy rates are not always 12¢ per kWh, and a new, fuel-efficient gasoline vehicle gets 40 MPG not 22 MPG.

Here's what happens when we adjust those costs for real life costs.

The fueleconomy.gov website puts the average MPG for a new gasoline fuel-efficient vehicle at 40 MPG[2]. If we are comparing the best fuel efficient EV to a gasoline vehicle, we should compare it to a new fuel-efficient gasoline vehicle. 40 MPG = 0.025 gallons of gas per mile, or 2.5 gallons per 100 miles driven.

A six-month running average cost of gasoline in California is $2.69 per gallon[3]. Our gasoline vehicle costs us $ 6.73 per 100 miles ($2.69 per gallon x 2.5 gallons per 100 mi = $6.73).

Off-peak EV electric rates are as low as 12¢ per kWh[4]. Medium demand is 24¢ per kWh, and peak demand is a staggering 44.5¢ per kWh. When you charge your vehicle depends on what you pay. Just a few hours of charging at medium demand rate or peak rate can put your kWh costs at 22¢ or more per kWh, costing $7.48 per 100 miles driven (34kWh x 22¢ = $7.48 per 100 miles driven). All of a sudden, our cost per mile driven for each vehicle is drastically different.

> Electric energy costs 22¢ per kWh (34kWh x .22 = $7.48 per 100 miles)
> At 15,000 miles per year, annual fuel cost is $1,122
> 5 year fuel costs = $5,610
>
> Gasoline vehicle gets 100 miles per 2.5 gallons
> Gasoline costs $2.69 per gallon (2.5 gallons x = $2.69 = $6.72 per 100 miles)
> At 15,000 miles per year, annual fuel cost is $1,008
> 5 year fuel costs = $5,040

Based on adjusted costs for energy, our gasoline vehicle is now less expensive per mile for fuel. With gas at $2.69 per gallon, our actual 5 year fuel savings is not a savings at all ($5,610-$5,040 = $570). You could actually PAY $570 MORE to fuel you EV.

Utility rates are constantly changing. Charging at the wrong time can be very expensive. The cost of gasoline could also easily rise above $5.00/gallon at anytime. Gas prices are certainly more volatile than electric utility prices, so it is most likely that a gasoline vehicle will cost you much more to drive per mile than an EV under most circumstances. I don't hold any hope in the price of gasoline staying at $2.69 per gallon in California for very long, nor do I

---

[2] https://www.fueleconomy.gov/feg/best/bestworstNF.shtml

[3] http://energyalmanac.ca.gov/gasoline/retail_gasoline_prices.html

[4] http://www.pge.com/en/mybusiness/rates/tvp/toupricing.page?WT.mc_id=Vanity_TOU

hold out any hope of electric rates holding at 12¢ per kWh, so I would be very cautious when calculating five-year fuel costs, and make sure to account for annual energy price increases of 6% per year.

This is, of course, why we recommend adding a solar energy system. With a solar electric system installed at your home, you have added another layer of cost savings that can be sized to produce the energy your home will need as well as to charge your EV. With a solar electric system, you are locking in your energy rates at todays' cost of solar for the life of the solar energy system. You are no longer at the complete mercy of grid utility rates and fluctuations. Now you can make accurate projections of your annual fuel costs for an EV.

Go into the decision to buy an electric vehicle with these factors in mind. Of course, we have not discussed the environmental impacts of an EV vs. gasoline vehicle, or the cost of repair and maintenance. These factors should also be considered. But at least now you understand the true cost per mile driven of electric vehicles over a gasoline vehicle. Happy shopping.