Plug-In Vehicle Fuel Economy

Battery Electric Vehicle Fuel Economy

Plug-in cars are getting plenty of attention, for a variety of reasons: they're pretty much oil-free, can cut emissions responsible for global warming, and have high-tech appeal. An all-electric vehicle like the Nissan Leaf is driven entirely on electricity and recharged from the electric grid. Its "fuel economy" can be compared to that of a gasoline-powered vehicle using an energy-based conversion factor of 33.71 kilowatts per gallon[i] to translate miles per kilowatt-hour (kWh) to miles per gallon (mpg). For the Leaf, which gets 3.14 miles per kWh in the city and 2.73 miles per kWh on the highway according to the EPA,[ii] that's equivalent to 106 mpg city and 92 mpg highway, or 98 mpg combined.[iii] That makes the Leaf nearly twice as energy efficient as the Toyota Prius hybrid at 50 mpg, for example. High efficiency translates into sizable savings at the "pump" — while the Prius costs $720 per year for fuel at $3 a gallon and 12,000 miles, the Leaf costs $400 a year to power, for the same distance traveled and at 10 cents/kWh.

Of course, the generation and distribution of the electricity used to charge the battery — and the resultant emissions of greenhouse gases and other pollutants — are not reflected in the above "in-use" energy efficiency comparison. Taking those losses into account, as well as the corresponding refining and distribution losses associated with gasoline, the electric vehicle's energy and emissions advantage over the hybrid vehicle is reduced, but not eliminated: charged on the average U.S. electricity generation mix, the Leaf generates 20 percent less greenhouse gas than the Prius does on a "full fuel-cycle" basis.

Plug-In Hybrid Fuel Economy

Energy consumption of a plug-in hybrid like the Chevrolet Volt — officially an "extended range electric vehicle" — involves both electricity and petroleum consumption from two modes of operation. The percentage of distance the vehicle would be driven in electric mode by a typical driver is termed the "utility factor" of the vehicle. A 0.6 utility factor indicates that the plug-in vehicle is expected to operate in electric mode 60 percent of its miles traveled; for the remaining 40 percent, it is driven on gasoline. A plug-in's utility factor is computed in turn from its "all-electric range," i.e., the distance it can travel on battery alone, together with data on the driving behavior of the American public.

Complicating matters is that the range and the utility factor of a vehicle can vary according to the type of driving. The Volt's electric performance is similar in city and highway driving, however — it has an all-electric range of about 35 miles and a utility factor of roughly 0.64 in both cases.[iv] The overall fuel economy for the Volt can be calculated from its city and highway fuel economies and utilities factors when running on electricity, together with its gasoline fuel economies. In all-electric operation, the Chevrolet Volt has fuel economy values of 2.81 miles/kWh city and 2.76 miles/kWh highway. Its gasoline fuel economy is 35 mpg city and 40 mpg highway. The final result is an overall fuel economy of 60 mpg-equivalent for the Volt.

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[i] http://www.epa.gov/fueleconomy/420r06017.pdf

[ii] These are the "adjusted" values — values that have been adjusted downward by 30 percent to reflect the difference between lab and real-world conditions. The EPA figure includes energy lost in charging the battery.

[iii] EPA's combined label numbers reflect a 55/45 percent city/highway rating, while ours use 43/57 percent city/highway, as explained in the Green Book methodology memo (http://greenercars.org/Meth%20Memo%20FINAL.pdf)

[iv] These are "Multiday Individual Utility Factors." See Society of Automotive Engineers, SAE J2841, September 2010 (http://standards.sae.org/j2841_201009/)