Making the Case for MPGe

In evaluating and comparing vehicles that are all powered only by gasoline, miles-per-gallon (MPG) makes great sense. But ***MPG isn't what it used to be.*** With the growing popularity of alternative fuels, and the emergence of vehicles powered by multiple fuels (most importantly electricity plus gasoline or other liquid fuels), MPG is quickly becoming obsolete.

Making the Case for MPGe:
Miles-per-gallon or energy equivalent (MPGe) offers a way to test alternative fuels on a level playing field. It is a measure that expresses fuel economy in terms of the energy content of a gallon of petroleum-based gasoline. Basically we ask: how much energy was delivered to the vehicle, and how far did it go? We convert the energy to the number of gallons of gasoline containing equivalent energy, and we express the result as miles per gallon. Our goal goes beyond conserving gasoline, but also conserving energy of all types.

Comparing the MPG of gasoline with the MPG of ethanol, for example, is like the proverbial comparison of apples to oranges; besides, ***what's a gallon of electricity?*** For a Plug-in-Hybrid-Electric-Vehicle (PHEV), MPG is even more misleading (at best, it tells just part of the story – e.g., accounting for just the liquid fuel but not the electricity).

As the figure of merit for fuel economy, the Progressive Insurance Automotive X PRIZE uses MPGe (miles per gallon or energy equivalent), defined as:

MPGe = (miles driven) / [(total energy of all fuels consumed)/(energy of one gallon of gasoline)]

MPGe is a simple, well-defined measure of overall vehicle efficiency. MPGe is easy to explain, accounts in a neutral manner for any combination of fuels, and reduces to the familiar MPG in the case of gasoline fuel only.

To make it easier to understand (and get some intuition about) MPGe, we've developed a spreadsheet available here. It includes three simple calculators:

1. Enter the distance driven and the amounts of all fuels consumed – result is MPGe. The formula for this calculation is the one given above.
2. For the special case of gasoline-electric PHEVs, enter the gasoline usage (MPG gasoline) and electricity usage (watt-hours per mile) – result is MPGe. The formula for this is given and discussed at length in my blog post available here.
3. For the case of any plug-in vehicle, enter the charging time and the charging efficiency – result, for three different electric circuit types, is the total energy added to the battery, expressed both as kWh and as (energy-equivalent) gallons of gasoline.

This is a hard time for the automotive industry. But it's also an exciting time of change and innovation. Consumers will soon have a variety of energy efficient and environmentally friendly vehicle choices as diverse technologies and alternative fuels come to market. This diversity will make it harder to evaluate and compare vehicles, and how best to do so is a difficult question. MPGe is not the entire answer, as it must be presented in the context of driving style, frequency, and distance. But we believe it's part of the answer. MPGe should be the new MPG.

For more information on MPGe, email progressiveautopress@xprize.org