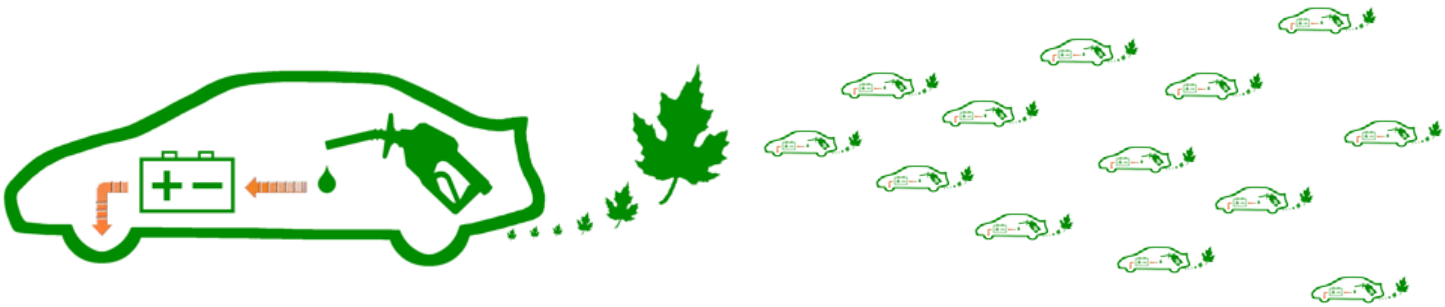
Highway Misconceptions



The basic design elements of a hybrid are easy to understand. For example, a combustion engine is inefficient when accelerating. Having an electric motor, which is more efficient, contribute power during those times will result in less fuel being used overall. That, combined with the knowledge that electricity is generated from energy normally lost from braking and the engine shuts off at stoplights, the design benefit becomes obvious for city driving. People readily recognize how those factors result in a MPG improvement.

On the highway though, many people believe the motor & battery in a hybrid become worthless, since speed remain relatively constant for long distances. They are quite incorrect. Few discover that error. Even fewer figure out why. The operation of a hybrid is unlike any other type of vehicle they have ever encountered. Among the types of hybrids themselves, there is quite a bit of variation too. So it is never wise to make assumptions.

This document points out what you need to know about the “full” hybrid system while driving on a highway. There are some subtle aspects of design & operation that account for significant efficiency improvements. Hopefully, you’ll gain a heightened sense of awareness to help bring an end to those misconceptions.

Also, keep in mind the unfortunate need for this document. There are some who mislead to impede the progress of hybrids. They intentionally spread false information to feed misconceptions.

Motor / Generator

The belief that the battery-pack is drained entirely while driving on the highway is the most common of hybrid misconceptions, often posted in a discussion forum without being challenged. Someone will make that claim, and it just gets accepted as if it were a well known fact. In reality, that is not what happens. Most of the time, the situation is the complete opposite. The battery-pack remains near the highest optimum charge-level.

Thinking that electricity is only generated when the vehicle's brakes are being used is the main source of the misconception. Many people don't realize that a majority of the electricity supply actually generates during those times when you are driving at a steady speed, never touching the brake pedal.

When the engine is running in a "full" hybrid, one of the two electric motors is spun. Sometimes that energy is used to generate electricity which is consumed immediately by the other electric motor. Sometimes it is used to recharge the battery-pack. Sometimes, both consuming & recharging take place simultaneously. Switching of use takes place many times per minute.

The fact that electricity is continuously being generated and its use alters so frequently is why the "*dead weight*" misconception has no real merit.

Accelerating

This particular subject is so poorly understood, the term "misconception" isn't strong enough to depict how often it's a problem in discussions about hybrids.

Most people simply assume that all hybrids work like the "assist" type, where electricity is drawn from the battery-pack when the vehicle is accelerating. That isn't always true for the "full" type. In fact, most modest speed merges onto the highway just use the electricity generated on-the-fly directly from the engine instead. That design allows the motor to contribute thrust to the wheels without being dependent on the battery-pack. By the way, this is a reason why the battery-pack lasts so much longer than people realize... yet another misconception!

More aggressive acceleration onto the highway yields unanticipated results as well. The "full" hybrid revs up the engine to an efficient level, sometimes faster than what is actually required. That extra energy is routed to generator and the resulting surplus electricity is sent to the battery-pack. Recharging while vehicle speed is increasing is counter-intuitive, a behavior misconceptions thrive on.

Battery-Pack

Even if the battery-pack was ever drained entirely, what difference would that really make? For the 2007 Prius, the weight of it is only 3.4% of the vehicle (99 of 2,921 pounds). And for the 2007 Camry-Hybrid, it is 4.1% (150 of 3,680 pounds). Highway efficiency wouldn't be affected much by such a minor percentage of weight influence. Then when you consider the fact that electricity is often provided by the engine directly, not drawing from the battery-pack, the electric motor still contributes to improved MPG. It's a feature unique to only the "full" type of hybrid.

Slowing Down

Did you know that slowing down without the use of the brake also causes electricity to be generated? Just a minor change of a single MPH will result in the battery-pack being recharged. Most people are completely unaware of that “full” hybrid benefit, an important gain rarely ever mentioned.

Since one of the electric motors is spinning anyway, a shift of the source of thrust from the engine to the wheels is automatic. Letting up a little pressure from the accelerator pedal is all it takes. Fuel is briefly cut from the engine and the excess kinetic energy transfers to the generator, which results in the vehicle slowing down a little bit. That happens more often than you’d expect while driving on the highway.

Engine Design

Size is typically smaller in a hybrid than its traditional counterpart. That alone provides an efficiency gain on the highway at fast speeds. Only a small amount of horsepower is required to sustain a cruising speed. Excess power capacity wastes fuel.

Pumping cycle is another aspect of efficiency, which is often not realized. For many of the “full” hybrids, the Atkinson-Miller cycle is used instead of the ubiquitous Otto. The result is a more efficient engine, due to the longer piston strokes and different valve timing. The tradeoff for that MPG gain is reduced horsepower. But on the highway, it isn’t needed anyway.

Internal component weight is commonly overlooked as well. Since hybrids use a powerful electric motor to start the engine and have a longer time available for the startup process, the parts within don’t have to be as robust. That decreased weight translates directly to higher efficiency during highway driving.

Mode Quantity

The marketing of new hybrid systems offering an additional mode is quite vague. With so little information, it is very easy to jump to an incorrect conclusion that the purpose of the added design complexity (and cost) is to overcome a highway efficiency shortcoming. You get the impression having less means just an improvement for city driving. That isn’t actually the case. There is a gain on the highway anyway.

Generically put, a traditional vehicle delivering a highway MPG of 30 could see an increase to 45 MPG with a single mode hybrid system. With another mode available, the MPG could be increased to 50. However, the configuration & power of propulsion components also contribute to efficiency. So don’t assume one design is always better than the other. Mode count alone is not a reliable measure of what to expect.

Carefully study real-world data. That’s the only true way of determining highway efficiency. Estimates and advertising are extremely misleading, often portraying just the ideal condition scenario.

Terrain & Traffic

Highways are never perfectly flat. Between the rapid response characteristic of an electric motor and the fact that its contribution can be as brief as only a second, efficiency improvement opportunities are abundant. Even the most subtle of incline or decline is taken advantage of. You'll see MPG fluctuate as the road pitch changes.

That same is true for traffic. Other vehicles cause you to slow down a little or accelerate a little. In those situations, most people don't realize there is a benefit from the hybrid system. They assume that only comes from using the brakes. That isn't true. Efficiency gains come from minor changes in speed too, like those caused by fast moving traffic on the highway.

Electric A/C

The only way a traditional vehicle can power a compressor for the A/C is to rely on a belt connected directly to the engine. It's a continuous draw with an observable MPG penalty. Electric A/C systems offer an ideal benefit for "full" hybrids, since electricity can be supplied with a better efficiency overall. Using a generator and battery-pack instead isn't an option available for traditional vehicles, only the "full" hybrid. The result of the A/C not having a direct dependency on the engine is better highway MPG.

Just Drive It

Some owners unknowingly contribute to this misconception, an innocent mistake that unfortunately provides those wishing to impede hybrid progress with a concept to exploit. And sadly, they do take advantage of that opportunity to intentionally mislead.

You don't have to drive Prius differently!

It's amazing how many people fighting Prius make the claim that you have to go way out of your way to achieve the fantastic efficiency. That simply isn't true. Owners know it. But providing proof of that is a serious dilemma online. You can't. The only response available is to raise awareness, hence this motto:

Just Drive It.

That advice is surprisingly effective. No special technique is needed. There is nothing to learn. You just drive a Prius on the highway the same way you would any traditional automatic vehicle. It is of course possible to squeeze out even higher MPG, but that is definitely *not* required.