How Hybrid Cars Work

Have you pulled your car up to the gas pump lately and been shocked by the high price of gasoline? As the pump clicked past $20 or $30, maybe you thought about trading in that SUV for something that gets better mileage. Or maybe you're worried that your car is contributing to the greenhouse effect. Or maybe you just want to have the coolest car on the block.

The auto industry now has the technology that might answer all of these needs. It's the hybrid car.

What Makes it a "Hybrid"?

Any vehicle is a hybrid when it combines two or more sources of power. For example, a moped (a motorized pedal bike) is a type of hybrid because it combines the power of a gasoline engine with the pedal power of its rider.

Hybrid vehicles are all around us. Most of the locomotives we see pulling trains are diesel-electric hybrids. Cities like Seattle have diesel-electric buses-these can draw electric power from overhead wires or run on diesel when they are away from the wires. Any vehicle that combines two or more sources of power that can directly or indirectly provide propulsion power is a hybrid.

The gasoline-electric hybrid car is just that- a cross between a gasoline-powered car and an electric car. Let's start with a few diagrams to explain the differences.

Hybrid Structure

You can combine the two power sources found in a hybrid car in different ways. One way, known as a parallel hybrid, has a fuel tank, which supplies gasoline to the engine. But it also has a set of batteries that supplies power to an electric motor. Both the engine and the electric motor can turn the transmission at the same time, and the transmission then turns the wheels.

By contrasts, in a series hybrid (Figure 4 below), the gasoline engine turns a generator, and the generator can either charge the batteries or power an electric motor that drives the transmission. Thus, the gasoline engine never directly powers the vehicle. Take a look at the diagram of the series hybrid, starting with the fuel tank, and you'll see that all of the components form a line that eventually connects with the transmission.

Why Build Such a Complex Car?

You might wonder why anyone would build such a complicated machine when most people are perfectly happy with their gasoline-powered cars. The reason is twofold: to reduce tailpipe emissions and to improve mileage. These goals are actually tightly interwoven.

California emission standards dictate how much of each type of pollution a car is allowed to emit in California. The amount is usually specified in grams per mile (g/mi). For example, the low emissions vehicle (LEV) standard allows 3.4 g/mi of carbon monoxide.

The key thing here is that the amount of pollution allowed does not depend of the mileage your car gets. But a car that burns twice as much as to go a mile will generate approximately twice as much pollution. That pollution will have to be removed by the emissions control equipment on the car. So decreasing the fuel consumption of the car is one of the surest ways to decrease emissions.

Carbon dioxide (Co2) is another type of pollution a car produces. The U.S government does not regulate it, but scientists suspect that it contributes to global warming. Since it is not regulated, a car has no devices for removing CO2 from the exhaust, so a car that burns twice as much gas adds twice as much CO2 to the atmosphere.

Automakers in the U.S. have another strong incentive to improve mileage. They are required by law to meet Corporate Average Fuel Economy (CAFÉ) standards. The current standards require that the average mileage of all the new cars sold by an automaker should be 27.5 mpg (8.55 liters per 100 Km). This means that if an automaker sells one hybrid car that gets 60 mpg (3.92 liters per 100 Km), it can then sell four big, expensive luxury cars that only get 20 mpg (11.76 liters per 100 Km)!