Hybrid Electric Vehicles

Hybrid Electric Vehicles (HEVs) are powered by two energy sources—an energy conversion unit (such as a combustion engine or fuel cell) and an energy storage device (such as a battery, flywheel, or ultra capacitor). The energy conversion unit can be powered by gasoline, compressed natural gas, hydrogen, or other alternative fuels.

HEVs can have either a parallel or series design. In a parallel design, the energy conversion unit and electric propulsion system are both connected directly to the vehicle's wheels. The electric propulsion system never drives the wheels alone, unlike a series design. The primary engine is used for highway driving; the electric motor provides added power during hill climbs, acceleration, and other periods of high demand. In a series design, the primary engine is connected to a generator that produces electricity. The electricity charges the batteries and drives an electric motor that powers the wheels.

Hybrid power systems were designed as a way to compensate for the limitations of **dedicated** EVs. Because batteries can only supply power for short trips, a generator powered by an internal combustion engine was added to increase range. An HEV can function as a purely electric vehicle for short trips, only using the internal combustion engine when longer range is required.

HEVs on the market today combine an internal combustion engine with a battery and electric motor, resulting in vehicles with 1.5 times the fuel economy of comparable conventional vehicles. Depending on driving conditions, one or both are used to maximize fuel efficiency and minimize emissions, without sacrificing performance.

An HEV battery is continually recharged by on-board sources. It has a generator powered by the internal combustion engine to recharge the batteries whenever they are low. A **regenerative braking** system captures excess energy when the brakes are engaged. This recovered energy is used to recharge the batteries.

Environmental Impacts

The HEV provides extended range and rapid refueling compared to conventional vehicles, as well as significant environmental benefits, reducing emissions by one-third. Their range and fuel economy make them attractive to consumers.

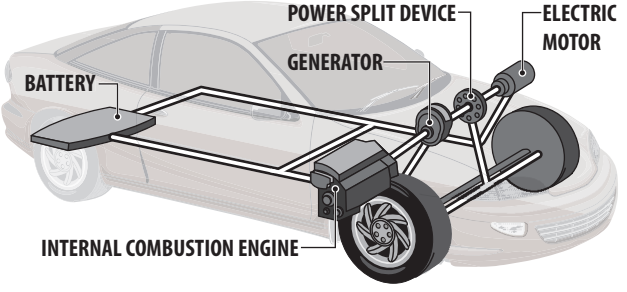
Hybrids Today and Tomorrow

In 2006, there were eight hybrid models available to the general public. In 2012, there are over 30 hybrid models available from almost every manufacturer. Today's hybrid vehicles include two seat passenger cars, four and five seat sedans, SUVs, and even full size pick up trucks capable of towing.

TOYOTA PRIUS

Image courtesy of NREL

How a Hybrid Electric Vehicle Works



Hybrid electric vehicles combine the benefits of gasoline engines and electric motors. Typically, the wheels are powered by an electric motor, and in some cases, the internal combustion engine assists. Hybrid electric vehicles do not need to be plugged in to charge the battery because they are charged by an onboard generator.

Plug-In Hybrid Vehicles (PHEVs)

PHEVs are very similar to HEVs. They have an internal combustion engine, an electric motor and a large battery pack. The larger battery pack in the PHEV gives it a range of 10-40 miles on an electric only range. When the battery is depleted the car continues to operate as a hybrid or gasoline vehicle.

The battery pack in a PHEV can be recharged by plugging it into a regular 120-volt electric outlet. People using a PHEV in an urban setting may be able to make their daily commute using all-electric power and then recharge the battery overnight to be ready for the next day's commute.

In 2012, there are only a few two PHEV models available on the market, but more are expected to be available soon.