89

# INTRODUCTION TO HYBRID VEHICLES





**Figure 89-1** View of the components of the General Motors electric vehicle (EV1). Many of the features of this vehicle, such as regenerative braking, currently used on hybrid vehicles were first put into production on this vehicle.

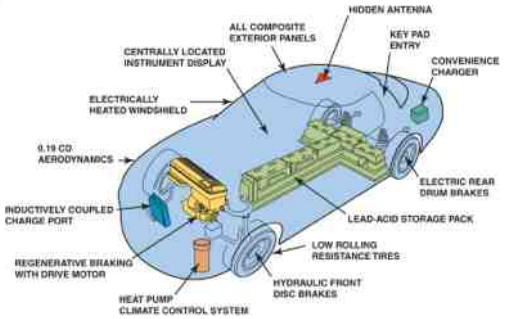
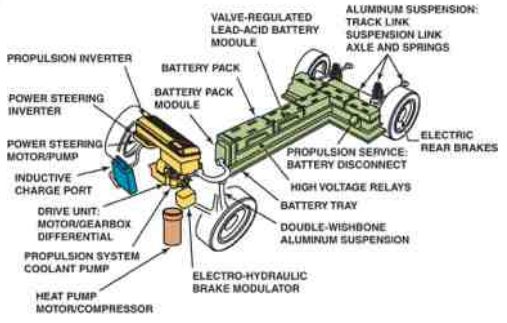







**Figure 89-2** Using a standardized plug to recharge an electric vehicle or a plug-in hybrid electric vehicle such as this Toyota Prius takes many hours depending on the voltage of the charger.



**FREQUENTLY ASKED QUESTION**

**How Fast Does the Motor-Generator Turn the Engine When Starting?**

The typical starter motor used on a conventional gasoline or diesel engine rotates the engine from 100 to 300 revolutions per minute (RPM). Because the typical engine idles at about 600 to 700 RPM, the starter motor is rotating the engine at a speed slower than it operates. This makes it very noticeable when starting because the sound is different when cranking compared to when the engine actually starts and runs.

However, when the motor-generator of a hybrid electric vehicle rotates the engine to start it, the engine is rotated about 1,000 RPM, which is about the same speed as when it is running. As a result, engine cranking is just barely heard or felt. The engine is either running or not running, which is a truly unique sensation to those not familiar with the operation of hybrid electric vehicles (HEVs).





**Figure 89-3** A drawing of the power flow in a typical series-hybrid vehicle.

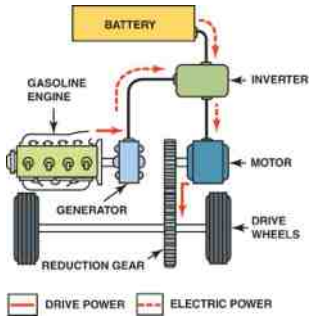







**Figure 89-4** This diagram shows the components included in a typical series-hybrid design. The solid-line arrow indicates the transmission of torque to the drive wheels. The dotted-line arrows indicate the flow of electrical current.

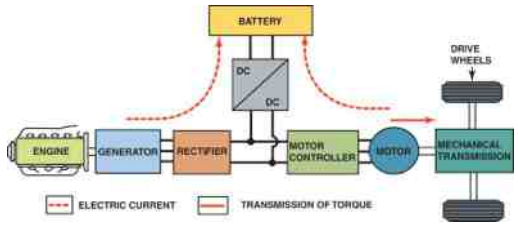
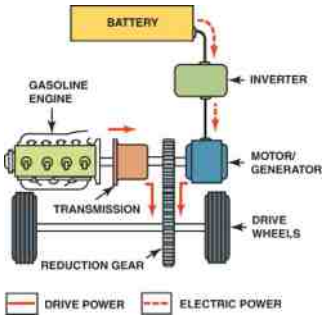


**Figure 89-5** The power flow in a typical parallel-hybrid vehicle.








**FREQUENTLY ASKED QUESTION**

**Is a Diesel-Hybrid Electric Vehicle Possible?**

Yes, using a diesel engine instead of a gasoline engine in a hybrid electric vehicle is possible. While the increased efficiency of a diesel engine would increase fuel economy, the extra cost of the diesel engine is the major reason this combination is not currently in production.





**Figure 89-6** Diagram showing the components involved in a typical parallel-hybrid vehicle. The solid-line arrows indicate the transmission of torque to the drive wheels, and the dotted-line arrows indicate the flow of electrical current.

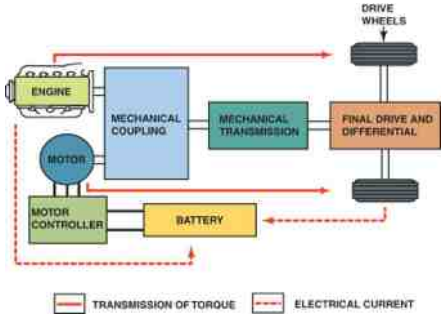


**Figure 89-7** A series-parallel hybrid design allows the vehicle to operate in electric motor mode only or in combination with the internal combustion engine.

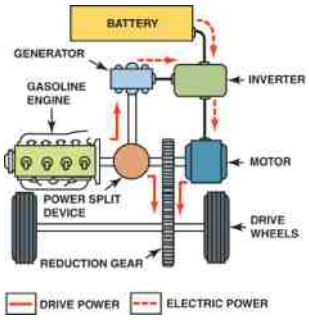







**Figure 89-8** This chart shows what is occurring during various driving conditions in a BAS-type hybrid.

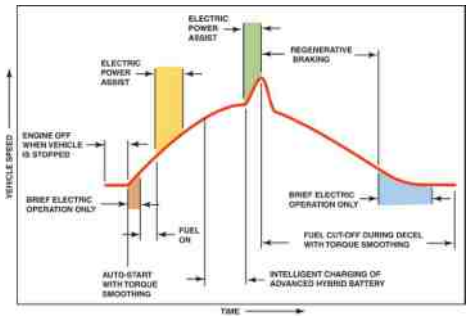







**Figure 89-9** The components of a typical belt alternator-starter (BAS) system.

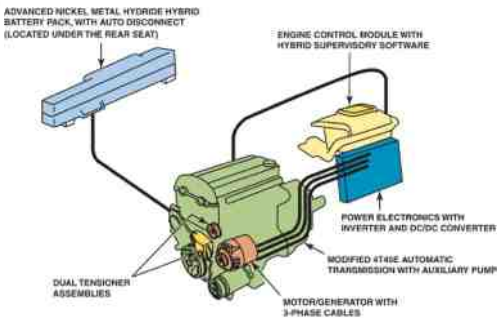


**Figure 89-10** This sticker on a hybrid vehicle allows the driver to use the high-occupancy vehicle (HOV) lanes even if there is only one person in the vehicle as a way to increase demand for hybrid vehicles in California.






**? FREQUENTLY ASKED QUESTION**

**Can Hybrids Use the HOV Lane?**

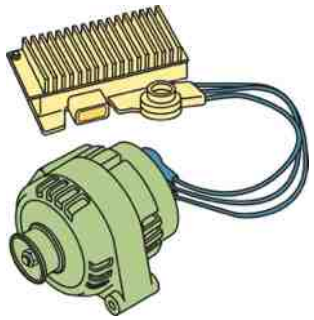
In most locations the answer is yes, but it depends on the type of hybrid vehicle. The **high-occupancy vehicle (HOV) lane** in many cities is reserved for use by vehicles that are carrying more than one occupant as a way to encourage carpooling and the use of public transportation. In California, only those hybrids classified as being high-fuel-economy models and those meeting certain emission ratings qualify. Those that do qualify, such as the Toyota Prius, are issued stickers that show that they are entitled to be in the HOV lane even if there is just the driver in the vehicle. High-performance hybrids, such as the Honda Accord hybrid, do not meet the specified fuel economy rating to allow the owners to be issued HOV stickers, which are also limited as to how many in the entire state can be issued.

● SEE FIGURE 89–10.





**Figure 89-11** A combination starter/alternator is used to provide idle stop function to conventional vehicles. This very limited and low cost system is called a micro-hybrid drive.



TECH TIP

**Watch Out for Motoring Mode**

When a hybrid electric vehicle is operating at low speeds, it is often being propelled by the electric motor alone, sometimes called motoring mode. As a result, the vehicle is very quiet and is said to be operating in **quiet mode.**

During this time, the driver should be aware that the vehicle is not making any sound and should be careful when driving in congested areas. Service technicians should also be extremely careful when moving a hybrid electric vehicle around the shop due to the silence of the vehicle.





Hybrid Features by Make/Model

| Make/Model | Idle Stop | Regenerative Braking | Motor Assist | Engine-Off Drive—EV Mode |
|---|---|---|---|---|
| Chevrolet Silverado 1500/GMC Sierra Hybrid | ✓ | ✓ | | |
| Ford Escape and Mercury Mariner Hybrid | ✓ | ✓ | ✓ | ✓ |
| Honda Accord Civic Hybrid | ✓ | ✓ | ✓ | |
| Honda Insight | ✓ | ✓ | ✓ | |
| Toyota Prius | ✓ | ✓ | ✓ | ✓ |
| Saturn VUE | ✓ | ✓ | ✓ | |
| Toyota Highlander/ Lexus RX hybrids | ✓ | ✓ | ✓ | ✓ |





FREQUENTLY ASKED QUESTION

**What Is an Assist Hybrid?**

An **assist hybrid**-electric vehicle is a term used to describe a vehicle where the electric motor is not able to start moving the vehicle on electric power alone. This type of hybrid would include all mild hybrids (36 to 42 volts), as well as the medium hybrids that use 144- to 158-volt systems.