which use electricity in combination with a gasoline engine. HEVs have been more commercially successful than pure EVs. Today, several HEV models are available to consumers, and more are appearing on the road every day.

Advantages of Hybrid Electric Vehicles

All HEVs combine the power of a battery-driven electric motor with the power of an ICE. However, different models do this in different ways. In a *series design,* an electric motor powers the car directly, while the ICE serves only to power a generator that recharges the battery for the electric motor. With this design, the ICE is very efficient because it is always recharging the battery. However, series-design HEVs have less power-on-demand for acceleration.

In a *parallel design,* both the electric motor and the ICE attach directly to the drive train to power the wheels. With this design, the electric motor provides the primary power when driving in stop-and-go traffic, while the ICE kicks in at higher speeds, when the ICE is more efficient. Unlike conventional gasoline-powered vehicles, parallel-design HEVs get better gas mileage and produce fewer emissions in town than they do on the highway.

Both series and parallel HEVs have longer driving ranges than their pure EV counterparts. Some HEVs can travel 700 miles before they need refueling. Furthermore, because the ICE charges the battery, an HEV never needs to be plugged in. In addition to maximizing the efficiency of the electric motor and the engine, many HEVs also have *regenerative braking* systems that recapture some of the power lost during braking and use it to recharge the battery. The result is a more efficient car that produces fewer emissions and gets better gas mileage than a comparable car powered solely by gasoline. HEVs are currently more expensive than conventional gasoline-powered cars, but the cost savings over time due to increased fuel economy may be enough to compensate for the greater initial price.

HEVs are a step toward solving the problems with air pollution and the politics of oil. As research continues, HEVs will likely become even more efficient. New technologies, such as hydrogen fuel cells, may replace the ICE component in HEVs, resulting in an even better car for the future.

Researching the Issue

1. Go to a local car dealer and ask about hybrid electric vehicles. Do they have any HEV models available? Are they going to offer any new HEV models in the future? Do these models use a series design, a parallel design, or another type of design?

2. Unlike pure electric vehicles, HEVs still burn gasoline in combustion engines. Do you think the increase in fuel economy and the reduced emissions of HEVs go far enough to address the problems at hand? What alternative or additional solutions can you recommend?

3. The federal government and some states offer tax deductions and other incentives for people who own HEVs or other alternative-fuel vehicles. Hold a discussion or debate on the question, "Should the government spend taxpayers' money to subsidize the purchase of alternative-fuel vehicles that people might otherwise not buy?"

4. Research hydrogen fuel cell technology. How do fuel cells work? Do they produce any harmful emissions? In what form is the hydrogen stored? What are some possible sources of hydrogen fuel? What problems must be solved before hydrogen fuel cells are ready for widespread use?

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