

Hybrid Electric Vehicles

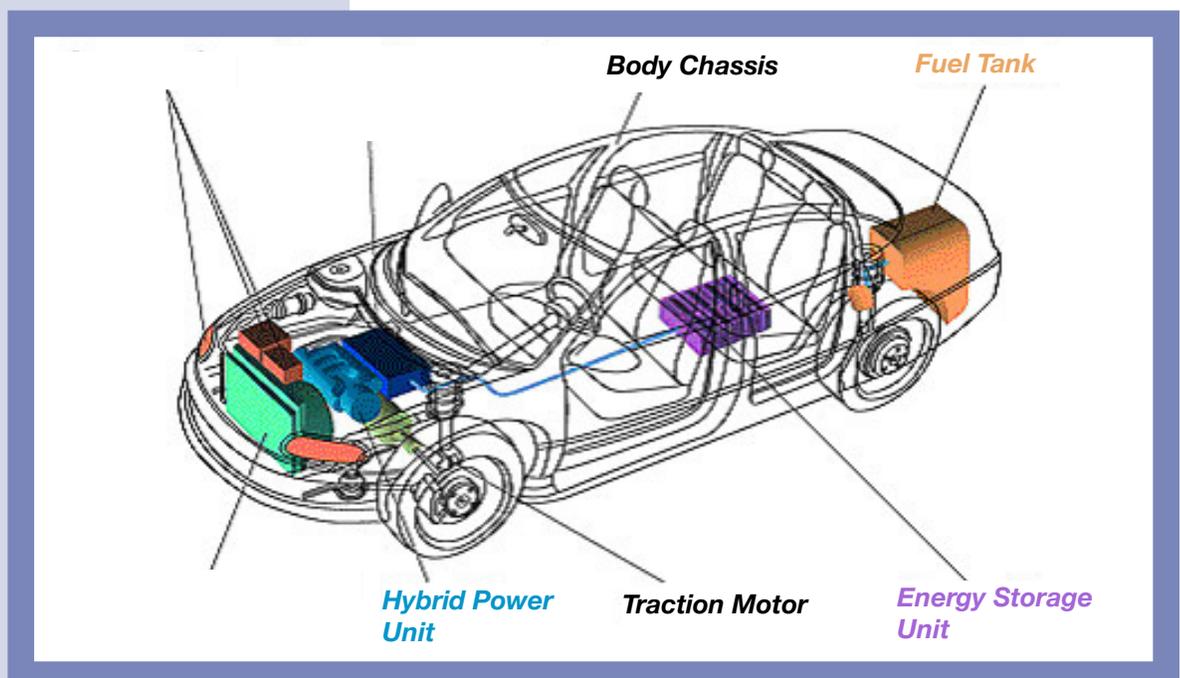
Hybrid electric vehicles (HEVs) offer reduced pollution and improved fuel economy. That's why the government and automakers are anxious to introduce a wide range of attractive and affordable models.

How Do HEVs Work?

HEVs have an electric motor and battery pack in addition to the internal combustion engine (ICE) found in traditional vehicles. The batteries in HEVs are lighter and smaller than those in nonhybrid electric vehicles because the ICE produces most of the power to operate the vehicle. The ICE can be designed to run on gasoline, diesel, or an alternative fuel. The battery pack or capacitor stores excess energy generated from braking to use for quick acceleration.

There are two types of HEVs: parallel and series. In parallel HEVs, the gas tank supplies fuel for the ICE and the batteries provide power to the motor. Both power the transmission, which turns the wheels. In series HEVs, the ICE does not directly power the vehicle but instead turns a generator, which sends power to either the motor or the batteries.

The main idea behind HEVs is the extra flexibility offered by the electric motor, which allows the engine to operate more efficiently. At low demand, the motor drives the vehicle using battery power. The ICE engages when needed to drive the wheels or recharge the battery. At full acceleration, the battery adds power; when the vehicle idles, the ICE shuts off.



How Do HEVs Compare with Conventional Vehicles

HEVs offer several advantages compared to conventional vehicles. They require fewer fill-ups and are more economical to run, getting up to 50 miles per gallon of fuel. Some have a driving range of about 600 miles — twice that of conventional vehicles (and six times that of electric vehicles). HEVs also emit fewer tailpipe pollutants because of their electric powertrains and efficient ICEs. In conventional vehicles, ICEs are designed to meet peak power needs (e.g., when the vehicle needs to climb a hill or accelerate). In HEVs, the engines can be smaller, lighter, cleaner-running, and designed to operate efficiently when meeting average power needs because the battery kicks in when extra energy is required. And the batteries are recharged automatically.

So far, five-year maintenance costs for HEVs have been lower than those for conventional vehicles. A great deal of progress has been made in improving the batteries so they will last for a vehicle lifetime of 150,000 miles or more. The main disadvantage of HEVs is their purchase price. To be commercially viable, hybrids should make up for their extra upfront cost in fuel savings over three years; manufacturers are working toward this goal.

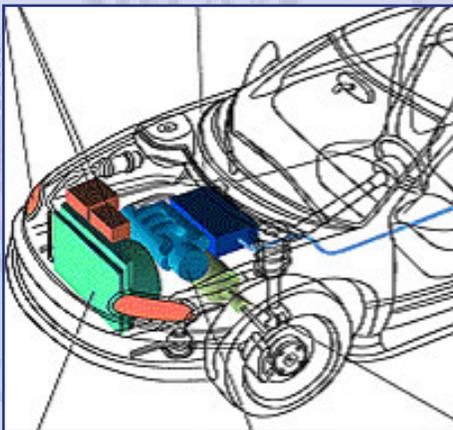
Quite a few HEVs are on the market now: Toyota, Honda, Nissan, Ford, Mazda, Mercury, Chevrolet, Saturn, Lexus, and GMC offer small, mid-size, and sport utility vehicle (SUV) models. Some buses and trucks combine diesel and electric technologies.

Advantages of HEVs

- Use less fuel, get better mileage, cost less to run
- Provide a quieter, better-quality ride
- Have more efficient engines
- Emit fewer pollutants (because they use less fuel and some run on alternative fuels)
- Emit fewer greenhouse gases that contribute to global warming
- Reduce our dependence on foreign oil and enhance national security

Disadvantages of HEVs

- Cost more to buy
- Have expensive batteries that might wear out before vehicle does
- Less safe (batteries may pose a danger to people unfamiliar with them, like mechanics or rescue workers at an accident scene)
- Create hazardous waste (used batteries need to be recycled or disposed of in a safe manner)



What Argonne is Doing

The best HEV should provide better fuel economy and performance, produce fewer emissions, and cost less to buy and operate than a conventional vehicle. To design such a vehicle, an almost endless number of technologies, components, and driving conditions must be studied. Funded by the U.S. Department of Energy's Vehicle Technology Program, Argonne National Laboratory researchers are developing and testing various HEVs and their components to identify the technologies, configurations, and engine control strategies that provide the best combination of high fuel economy and low emissions.

