Argonne NATIONAL LABORATORY

Hybrids: No Longer Cars of the Future

Did you know...

A hybrid electric vehicle (HEV) recharges its batteries primarily by using its own gasoline engine, in addition to regenerative braking. This "self-charging" system greatly enhances driving range — to more than 600 miles in the city on one tank of gas.

What is a hybrid electric vehicle?

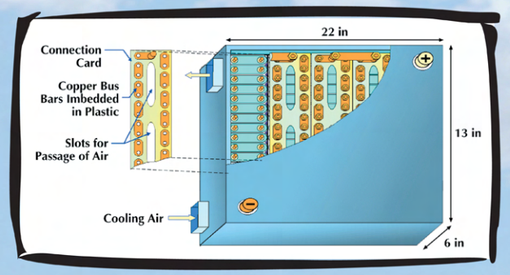
A hybrid is any vehicle that uses two or more sources of power — in today's HEVs, the two sources are electricity (from batteries) and mechanical power (from a small internal combustion engine). HEVs can offer the very low emissions of electric vehicles with the power and range of gasoline vehicles. They also offer up to 30 more miles per gallon, perform as well as or better than, and are just as safe as any comparable gasoline-powered car. Plug-in HEVs of the future will be capable of achieving 100+ miles per gallon. Widespread use of HEVs would help reduce our nation's growing dependence on foreign oil and cut greenhouse gas emissions by one-third to one-half.

Opportunity

Present day hybrid electric vehicles use nickel metal hydride (NiMH) batteries. With its high energy and power densities, however, a lithium-ion (Li-ion) battery offers a volume and weight savings of approximately 60% over an advanced lead acid battery and approximately 30% over a NiMH battery. This means less weight and more room for comfort in the vehicle. Before Li-ion batteries can be used in electric or hybrid electric vehicles, issues involving battery life, cost, and tolerance to abuse must be resolved.

Argonne's Solution

With over 30 years of experience in developing new battery materials and evaluating their performance, Argonne is uniquely qualified to help solve the key research issues for Li-ion batteries. If solved, Li-ion batteries have the potential to be lower in cost than the relatively expensive NiMH batteries.



Industry Partnership

In the mid-1990s, the U.S. Department of Energy (DOE) Advanced Vehicle Technologies Program partnered with USCAR, an alliance of U.S. automakers, in precompetitive research to jointly develop essential, "core" hybrid vehicle technologies. To date, this research (in which Argonne played a role through DOE's FreedomCar and Vehicle Technologies Program) has helped foster the development of the Ford Escape Hybrid SUV and the General Motors Silverado/Sierra Full-Size Hybrid Pickup Truck — both of which are now available to consumers.

These and other DOE industry partners were able to apply, and expand on, the results from DOE-sponsored, precompetitive hybrid research as they developed their proprietary technologies and products to meet the specific needs of their customers.

When engine demand is low, such as when starting, traveling at a light load, or stopping, an HEV is driven only by its electric motor, using battery power.

During normal travel, the gasoline engine engages as needed to (1) drive the wheels and/or (2) recharge the battery.

At full acceleration, the battery adds its power to the mix, which provides a very smooth and powerful response.

When decelerating or braking, the regenerative braking system acts as a generator to help recharge the battery.

The engine shuts off when the car is idling or if engine demand is low. The gasoline engine runs only as needed to recharge the battery or run the air conditioner, which is why an HEV never has to be plugged in for recharging.

The future HEV can be plugged in at night to top off the car's more powerful Li-ion battery — extending the car's range to over 100 mpg!

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