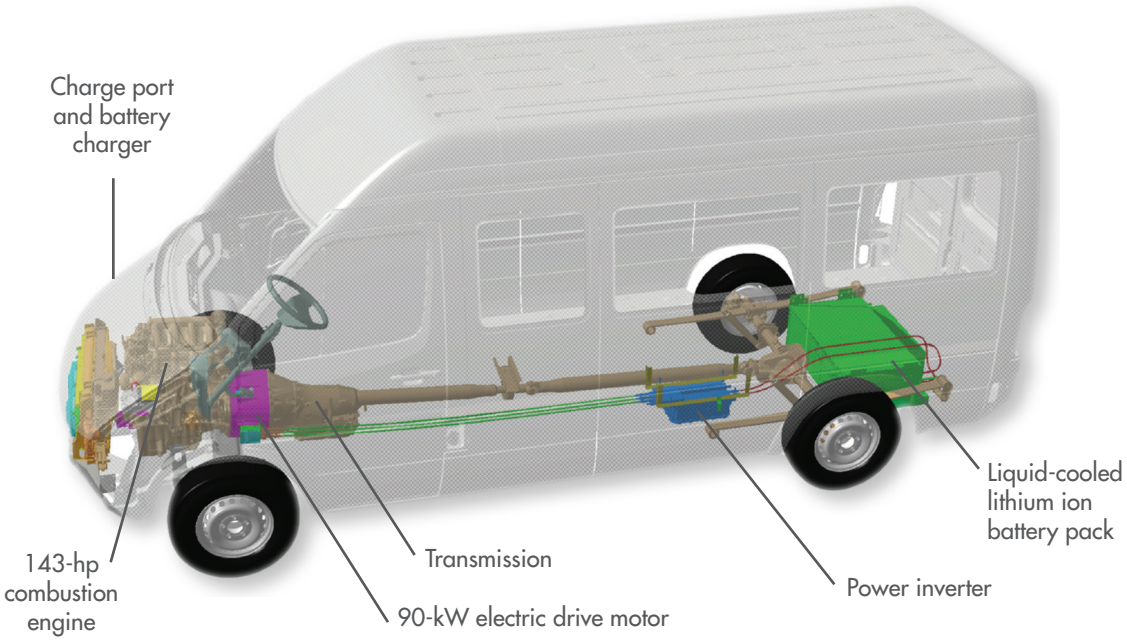
Technology Primer: The Plug-in Hybrid Electric Vehicle

The Plug-in Hybrid Electric Vehicle (PHEV), like current hybrid electric vehicles (HEV) available on the market today, operates on battery power for a clean, quiet ride, and on liquid fuel for unlimited driving range. In both vehicles, the battery charges when its internal combustion engine (ICE) is running and when the driver uses the brakes. When the battery depletes its charge to a preset minimum energy level, the vehicle automatically switches to ICE mode. A key distinction between the two is that the PHEV gains its primary energy directly from the electricity grid while the HEV derives its propulsion energy from gasoline.



More than 40% of U.S. generating capacity operates at reduced load overnight, and it is during these off-peak hours that most PHEVs would be recharged. Recent studies show that if PHEVs displaced half of all vehicles on the road by year 2050, they would require only an 8% increase in electricity generation (4% increase in capacity).

At Issue: Cost of Advanced Batteries

The performance and practicality of a PHEV depends on the weight of the battery in relation to the amount of energy it can store and the power it can produce: the lighter and more compact the battery, the more efficient and practical the vehicle; the more energy the battery stores, the longer the vehicle's driving range.

Today's advanced batteries, principally the nickel metal hydride (NiMH) and the lithium ion (Li-Ion), have demonstrated the high energy storage, power delivery, and longevity characteristics needed to make PHEVs competitive with conventional vehicles in performance. The biggest barrier to their use is cost.

Both NiMH and Li-Ion are expensive to produce. However, just as the cost of the small NiMH and Li-Ion batteries used in consumer electronic devices has dropped dramatically, the cost of PHEV batteries is expected to drop as they go into mass production and as worldwide competition for that market develops.

PHEV Development Status

The development of PHEV technology has gained momentum within the past few years along with growing concerns for the price of gasoline, global climate change, national security and electric load management at electric companies.

- Automakers recognize a consumer market eager to reduce transportation fuel costs. With the national average cost of electricity at 8.5¢ per kilowatt-hour, a PHEV runs on an equivalent of roughly 75¢/gallon of gasoline; this compares favorably with an average national cost of gasoline of $3/gallon.
- Policy-makers have embraced the PHEV as a way to reduce greenhouse gas emissions, and to improve air quality. The PHEV has, in fact, become a key to the nation's flexible fuel option strategy.
- The federal government supports PHEV technology as a national security imperative that would lessen our nation's reliance on petroleum imports.

A PHEV can be a vehicle of any size; however, the earliest market targets are fleet vehicles—delivery vans, shuttle buses, and maintenance vehicles. For many local service and government organizations, fleet vehicles can run cleanly and quietly on city streets during the day and plug in at night. Vehicles with short routes may never need to visit a gas station.

A PHEV sedan can be charged through a 120-V outlet in three to four hours, and a commercial delivery van charges in about four to five hours on a 240-V connection typically found in commercial garages. The PHEV will have an onboard charger that plugs into an electric outlet, or it can be plugged into a charger installed in a service garage. In the future, automakers may offer docking stations: when the vehicle arrives at a workplace parking lot or in a home garage, it rides onto docking platform and charges automatically, without a plug.

Major auto manufacturers—General Motors, DaimlerChrysler, Ford, and Toyota, among others—are testing a variety of prototype PHEVs. EPRI expects PHEVs to be available for commercial van application by 2008 and in the mass consumer market by 2010.

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