Ford F550 Hybrid: Anatomy of a $90 million public-private partnership
Hybrid trucks
A decade long collaboration combines with public funds to bring new technology

By Maryruth Belsey Priebe, special to the Green Economy
private initiative
to fruition.

Foresight and determination are absolutely necessary for solving environmental problems. And at times, simply exercising these characteristics is all that’s needed to attract the right partners and funding for getting the job done.

At least that was the case for three organizations that recognized the need for plug-in hybrid electric vehicles (PHEVs)—Electric Power Research Institute (EPRI), Eaton Corporation, and South Coast Air Quality Management District (AQMD). With iron will and a clear vision for cleaner commercial transportation, they embarked on a journey that, unbeknownst to them, would eventually land them a hefty American Recovery and Reinvestment Act (ARRA) grant many years later.

When EPRI first identified hybrids as important for their member utilities in 1999, the issue of electric commercial vehicles was essentially dead. Yet the necessity for more efficient commercial fleets was great. With utility vehicles
“With public support, it is likely that someday millions of Americans will fill up their vehicles at the plug instead of the pump, saving money and protecting the environment.”

John E. Bryson
Chairman and CEO
Edison International

**WHAT IS A PHEV?**

PHEVs or Plug-in Hybrid Electric Vehicles, use grid electricity as a transportation fuel, reducing both direct emissions at the vehicle tailpipe, and indirect emissions at the fuel source when they recharge by electricity produced by a portfolio of efficient combustion, non-emitting or renewable generation.

Plug-in hybrid electric vehicles combine operational aspects of both battery electric vehicles (BEVs) and power assist hybrid electric vehicles (HEVs). A PHEV, like a BEV, can be recharged from the electric grid, stores energy in an onboard battery and uses the energy while depleting the battery during daily driving.

Unlike a BEV, a PHEV can use its internal combustion engine in highway driving or when the battery is depleted. Because of this versatility, a PHEV can serve as a direct replacement for a conventional internal combustion engine vehicle or HEV.
This funding is an important milestone in the advancement of plug-in hybrid vehicles, and Eaton is pleased to be a recipient. By providing our sustainable, energy-saving technologies to power the vehicles as well as the electrical infrastructure support to help keep them running, we believe we can provide ... the technology ... to move plug-in hybrids to the next level."

Alexander M. Cutler
Chairman and CEO
Eaton

weighing at times in excess of 19,000 pounds, and the need for these monstrous engines to run nearly all day to power heavy booms, fuel consumption and likewise greenhouse gas emissions were a big concern. So EPRI took up the challenge to stimulate the development of commercial PHEVs. It wasn’t long before the AQMD caught the vision and co-funded EPRI’s PHEV research.

Independently, Eaton, a diversified power management company, began development of their first diesel hybrid system a few years later. Seeing parallel interests between their two organizations, EPRI soon contacted Eaton to begin discussions to work together on the development of efficient commercial fleets. The next several years saw continued testing of various commercial vehicles—from a prototype Sprinter PHEV, to a plug-in gasoline hybrid shuttle bus, and eventually a Ford F550 diesel utility truck.
Companies such as FedEx, UPS, Coca-Cola Enterprises, PepsiCo and Wal-Mart are now using delivery vehicles with hybrid systems. Alexander M. Cutler, chairman and chief executive officer of Eaton, a global leader in the production of hybrid power systems for trucks and buses, says the technology needed to move plug-in hybrids to the next level is here. Supporting him are dozens of utility and telecom systems across North America, including Pepco, American Electric Power, Pacific Gas and Electric, Southern California Edison, Florida Power and Light and more than 50 utility and municipal fleets nationwide.

All have found fleet savings in vehicles that integrate an internal combustion engine with an electric motor that can be recharged overnight.

### THE PARTNERS

<table>
<thead>
<tr>
<th>Key Player</th>
<th>Status</th>
<th>Role</th>
<th>Responsibility</th>
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<tbody>
<tr>
<td>Altec Industry</td>
<td>Private Industry</td>
<td>Truck body builder</td>
<td>• Installation of plug-in hybrid system into individual vehicles</td>
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<td></td>
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<td>• Ongoing warranties</td>
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<td></td>
<td></td>
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<td>• Financial services (leasing) to fleets</td>
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<td>AQMD</td>
<td>Californian Public Agency</td>
<td>Project lead</td>
<td>• Some program management</td>
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<td></td>
<td></td>
<td></td>
<td>• Emissions testing</td>
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<tr>
<td>A123</td>
<td>Private Industry</td>
<td>Supplying battery system</td>
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<tr>
<td>Eaton</td>
<td>Private Industry</td>
<td>Technical lead</td>
<td>• Development of hybrid plug-in system</td>
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<td></td>
<td></td>
<td></td>
<td>• Vehicle charging infrastructure</td>
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<tr>
<td>EPRI</td>
<td>Nonprofit research and public policy organization</td>
<td>Project manager</td>
<td>• Broad management of project</td>
</tr>
<tr>
<td>Southern California Edison</td>
<td>Regulated, investor-owned utility</td>
<td>Vehicle purchaser</td>
<td>• Vehicle and battery evaluation</td>
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Yet it wasn’t until nearly 10 years after the vision was first conceived that the group got a big break. In March 2009, the US Department of Energy (DOE) announced ARRA funding for the electrification for transportation, putting in motion a dizzying sequence of events that would lead inevitably to the solidification of relationships and research that had been developing for the past decade. And with these new funds, speedy progress could now be made. “It would have been an incremental process [without the stimulus funds], which is much harder,” comments Mark Duvall, Director, Electric Transportation.

EPRI, Eaton, and AQMD certainly could not have anticipated the events that led to the award of their $45.4 million grant from the DOE, yet by leveraging the work they’d done over the past 10 years, they are now in the position to make significant progress. And once the DOE project is complete in approximately four years, their vision for efficient commercial fleets will have come to fruition, and a production-level fleet will be ready to roll out, available to whoever wants to buy them.

Though the testing phase of the project is not yet complete, the initial designs are impressive. Unlike traditional utility trucks that run the engine to power the boom for the better part of a day, the new PHEVs can operate for many hours using only electricity. And they recharge by plugging into either individual smart charging stations or a regular 120V outlet, which can power-up the vehicle overnight. As an added benefit, these trucks no longer contribute to noise or air pollution when onsite, making them attractive especially in residential locales.

More important, the EPRI-Eaton approach—as opposed to existing systems for utility applications—provides regeneration, launch assist and electric power. Regeneration converts the kinetic energy of braking into a useful form of energy, instead of dissipating it as heat as with conventional brakes. Regeneration is then paired with launch assist, which uses the energy stored through braking for the high power demands of starting, thereby extending battery life. Regeneration, launch assist and the

“We now see that widespread use of PHEVs could expand the fuel options in our transportation sector and at the same time yield net benefits to our environment.”

Steve Specker
President and CEO
EPRI
ENVIRONMENTAL IMPACT OF PHEV

The NRDC (National Resources Defense Council), and EPRI (Electric Power Research Institute) jointly published the Environmental Assessment of Plug-In Hybrid Electric Vehicles. They looked at nine scenarios derived from the worst case—expensive, inefficient (high carbon) electricity, and low PHEV adoption, to best case—lower cost, efficient electricity and high PHEV adoption. Their conclusions are summarized below.

Q. Can the grid support large scale use by the transportation sector?
A. There is an abundant supply of electricity for transportation; a 60 percent U.S. market share for PHEVs would use 7 percent to 8 percent of grid-supplied electricity in 2050.

Q. Will PHEV really make a difference in air quality and greenhouse gas reduction?
A. Widespread adoption of PHEVs can improve nationwide air quality and reduce GHG emissions from vehicles by more than 450 million metric tons annually in 2050 -- equivalent to removing 82.5 million passenger cars from the road.

Q. Is this the best case scenario?
A. The study looked at 9 scenarios ranging from the most favorable—efficient, low cost electricity, high PHEV adoption—to the least favorable—inefficient (high carbon), expensive electricity and low PHEV adoption. Across all scenarios annual and cumulative GHG emissions are reduced significantly. Annual GHG emissions reductions were significant in every scenario, reaching a maximum reduction of 612 million metric tons in 2050 (High PHEV fleet penetration, Low electric sector CO2 intensity case). Cumulative GHG emissions reductions from 2010 to 2050 can range from 3.4 to 10.3 billion metric tons, and will positively affect every region of the country.

Q. Will PHEV’s help reduce our dependence on foreign oil?
A. PHEVs can reduce petroleum consumption by 3 million to 4 million barrels per day by 2050.

NRDC believes that a combination of more efficient vehicles, improved battery technology, and a lower-emitting electric power plant fleet can produce substantial reduction in global warming pollution from both the electric power and the transportation sectors. Our results show that PHEVs recharged from low- and non-emitting electricity sources can decrease the carbon footprint in the nation’s transportation sector.”

David Hawkins
Director, Climate Center
NRDC
The production and demonstration of this fleet of vehicles is a significant step in driving PHEV technology beyond the personal transportation platform to a daily work application. This project leverages Eaton’s current hybrid electric system and builds upon nearly three years of ongoing work by Eaton and EPRI to develop PHEV technology for commercial vehicles.”

Mark Duvall,
Director of Electric Transportation
EPRI

The ability of the vehicles to run in battery only mode, dramatically reduces fuel consumption and emissions.

Certainly long-term relationships between key players made for a smooth transition from planning to implementation. This was especially necessary given the constraints of a tight timeline: approximately six weeks from the funding opportunity announcement to submission of the proposal. It was also beneficial to be working with organizations that possessed a proven track record with government-funded research and development projects.

Perhaps equally important has been the shared risk inherent in the proposal structure. “These are tough financial times and we recognize that the cost-share requirement was significant in the funding opportunity,” explains Pat Davis, program manager of vehicle technologies at the DOE. “It’s hard for a single entity to put up half of the cost of the project, so getting a team together and each sharing some of the burden was important.” The DOE’s opportunity announcement contained big requirements: domestic manufacturing, production of at least 100 electric, plug-in hybrid, or fuel cell vehicles, long-term evaluation of the finished product, and a cost-share arrangement that would leave only 50 percent of the bill with the federal government.

In the end, there were a total of five financial partners including 50 fleets committing to the purchase of the finished PHEVs, as well as other entities offering technological expertise and manufacturing support. Each came to the table with unique but necessary expertise, and each will benefit from the arrangement. This public-private-nonprofit partnership serves as a model for how to organize diverse groups around a single cause to achieve substantial financial gains.

**LINKS**

- **Comparing the Benefits and Impacts of Hybrid Electric Vehicle Options for Compact Sedan and Sport Utility Vehicles** - Published by EPRI
- **Plug-In Hybrids on the Horizon: Building a Business Case** - Published by EPRI
- **South Coast Air Quality Management District**
  October 2, 2009 Meeting Agenda, including detailed breakdown of funding for the project