

THE **Green** Economy

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INNOVATION FOR A PROSPEROUS PLANET



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
ologies to fruition.



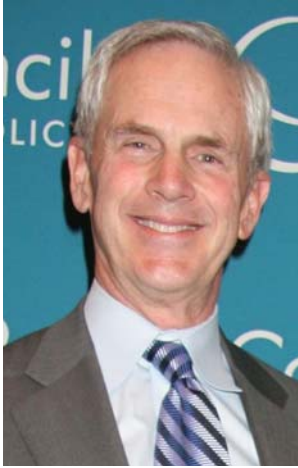
Foresight and determination are absolutely necessary for solving environmental problems. And at times, simply exercising these characteristics is all that's needed to attract the right partners and funding for getting the job done.

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.

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“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?

PHEV

*Plug in Hybrid
Electric Vehicle*

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.

BEV

*Battery Powered
Electric Vehicle*

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.

HEV

*Hybrid Electric
Vehicle*

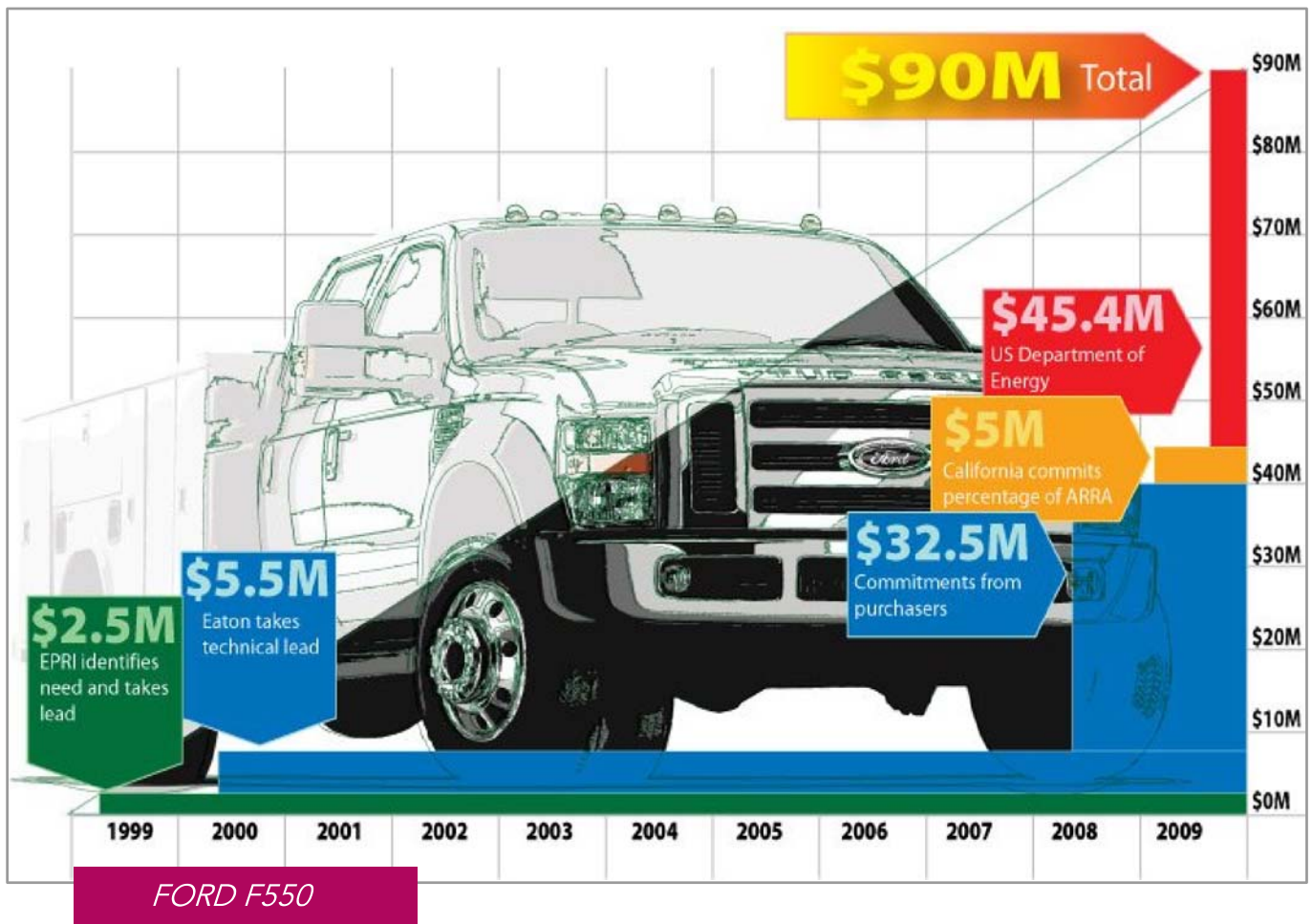
Unlike a BEV, a PHEV can use its internal combustion engine in highway driving or when the battery is depleted. Because of this versatility, a PHEV can serve as a direct replacement for a conventional internal combustion engine vehicle or HEV.

ICE

*Internal Combustion
Engine*

Sprinter Delivery Trucks





“ 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.

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THE PLAYERS

EPRI

Electric Power Research Institute

Project manager; Overall project management

Eaton

Technical lead; Development of hybrid plug-in system and charging infrastructure

AQMD

South Coast Air Quality Management District

Project lead; some program management; emissions testing

SCE

Southern California Edison

Evaluating vehicles and batteries

A123

Battery system

Ford

OEM chassis and powertrain technical support

Altec Industry

Truck body builder; installation of plug-in hybrid system into individual vehicles; offers ongoing warranties and financial services (leasing) to fleets

CEC

California Energy Commission

Provides funds through cost-sharing ARRA awards

US DOE

US Department of Energy

Funding for transportation electrification through ARRA

ARRA

American Recovery and Reinvestment Act

Stimulus funding

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

Key Player	Status	Role	Responsibility
Altec Industry	Private Industry	Truck body builder	<ul style="list-style-type: none">• Installation of plug-in hybrid system into individual vehicles• Ongoing warranties• Financial services (leasing) to fleets
AQMD South Coast Air Quality Management District	Californial Public Agency	Project lead	<ul style="list-style-type: none">• Some program management• Emissions testing
A123	Private Industry	Supplying battery system	
Eaton	Private Industry	Technical lead	<ul style="list-style-type: none">• Development of hybrid plug-in system• Vehicle charging infrastructure
EPRI Electric Power Research Institute	Nonprofit research and public policy organization	Project manager	<ul style="list-style-type: none">• Broad management of project
Southern California Edison	Regulated, investor-owned utility	Vehicle purchaser	<ul style="list-style-type: none">• Vehicle and battery evaluation



President Obama inspecting PHEV truck.
Courtesy Southern California Edison

For utility truck application, the plug-in hybrids are based on the Ford F550 chassis and will have a total range of at least 300 miles. The system will provide fuel economy improvement of up to 70 percent when compared to a standard utility vehicle, with similar reductions in emissions and noise.

The entire system can be recharged by plugging it into a standard 120- or 240-volt electrical outlet. In addition, the trucks will be capable of powering auxiliary equipment and tools while stopped at a worksite.



“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*

◀◀ 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

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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.

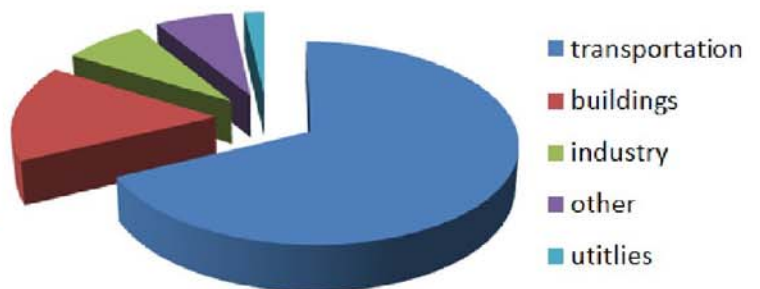
Q Is this the best case scenario?

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.

PETROLEUM USE BY SECTOR



RITA: Bureau of Transportation Statistics



“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*

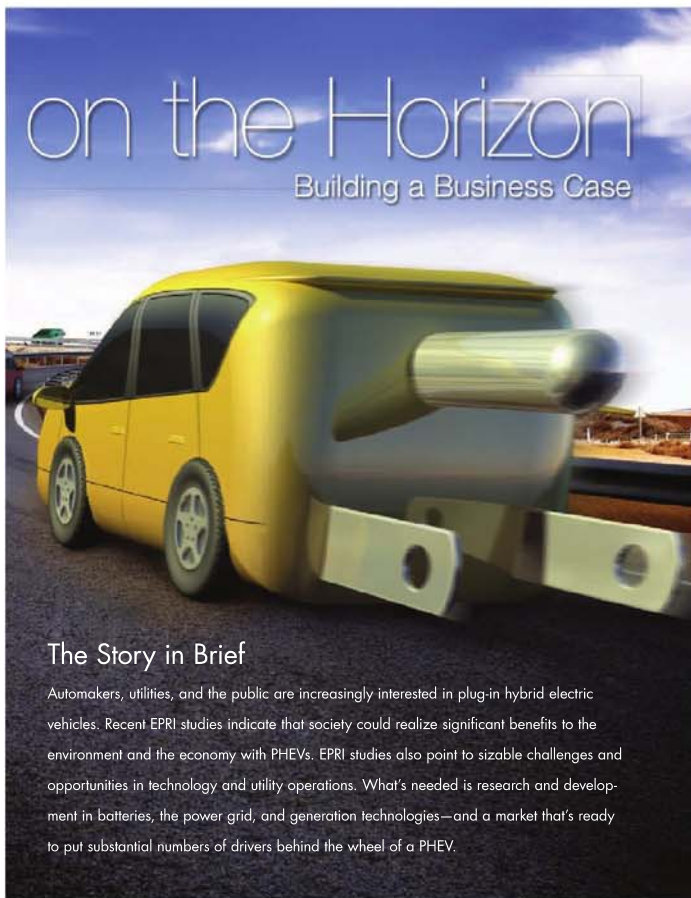
◀◀ ability of the vehicles to run in battery only mode, dramatically reduces fuel consumption and emissions.

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