PLUG-IN ELECTRIC VEHICLES

PLUG-IN ELECTRIC VEHICLES

WHAT ROLE FOR WASHINGTON?

David B. Sandalow
editor

BROOKINGS INSTITUTION PRESS
Washington, D.C.

1775 Massachusetts Avenue, N.W., Washington, D.C. 20036
www.brookings.edu

Library of Congress Cataloging-in-Publication data

Plug-in electric vehicles : what role for Washington? / David B. Sandalow, editor.
p. cm.
Includes bibliographical references and index.
Summary: "Explains the current landscape for plug-in electrics and implications for national security, the environment, and the economy. Discusses what can and should be done by the U.S. government to advance the role of plug-in electric vehicles"—Provided by publisher.
ISBN 978-0-8157-0305-1 (cloth : alk. paper)
1. Electric vehicle industry—United States. 2. Electric vehicles—Government policy—United States. 3. Hybrid electric vehicles—Government policy—United States. I. Sandalow, David.
HD9710.U52P54 2009
388.3'2—dc22 2009000791

1 3 5 7 9 8 6 4 2

The paper used in this publication meets minimum requirements of the American National Standard for Information Sciences—Permanence of Paper for Printed Library Materials: ANSI Z39.48-1992.

Typeset in Sabon and Strayhorn

Composition by R. Lynn Rivenbark
Macon, Georgia

Printed by R. R. Donnelley
Harrisonburg, Virginia

CHAPTER THIRTEEN

Promoting Use of Plug-In Electric Vehicles through Utility Industry Acquisition and Leasing of Batteries

PETER FOX-PENNER, DEAN MURPHY, MARIKO GERONIMO, and MATTHEW MCCAFFREE

Petroleum is the predominant transport fuel in the United States. It is supported by a vast and ubiquitous infrastructure, it is easy to transport, and until recently it was relatively inexpensive. But as prices continue to rise, there is greater recognition of the destabilizing geopolitical effect of the country's overdependence on petroleum. Looming federal greenhouse gas (GHG) regulation will add to the price of petroleum-based fuels in the years to come, and it provides greater motivation to address transportation GHG emissions today. While multiple alternatives are being sought, one of the most promising near-term solutions—one that will leverage existing infrastructure, reduce GHG emissions, and allow drivers the same freedom and mobility as they enjoy with today's vehicles—is the plug-in electric vehicle (PEV), or "plug-in."[1]

While plug-in electric vehicle technology exists today and holds the greatest promise to reduce demand for oil, PEVs currently carry a price premium, in large part due to the extra cost of the high-capacity battery that they require. In order to bring these cars to market more rapidly, it is in the interest of consumers, manufacturers, the federal and some state governments, and utilities to work to remove this initial first-cost barrier. Since PEVs would rely on electricity from the grid, either wholly or partially, electric utilities could be on the brink of becoming a major part of the transportation sector and could benefit considerably from the wide-

spread deployment of PEVs. They are uniquely positioned to collaborate with the federal and state governments and car manufacturers to bring the vehicles to market quickly and to use creative approaches to do so.

The Role of Plug-In Hybrids in U.S. Energy Strategy

Most Americans drive less than thirty miles a day, which means that PEVs would give them the option to fuel their cars at home on domestic fuel with fewer emissions. The potential for PEVs to contribute to a comprehensive energy strategy has led to broad agreement across the U.S. political spectrum that this technology is one key to achieving U.S. energy security and reducing greenhouse gases. The Bush administration, both candidates in the 2008 presidential election, leading environmental groups, and congressional leaders from both sides of the aisle are on the record supporting PEV development to reach those goals.

Aggressive research, development, and demonstration (RD&D) is under way for plug-ins, financed by both public and private funding. The Energy Independence and Security Act of 2007 provides for grants and RD&D programs to develop PEVs, and proposals to spur sales through tax credits (much like those introduced for hybrid vehicles) have enjoyed bipartisan support. A123Systems is now selling its Hymotion conversion kits to turn internal combustion hybrids into plug-ins. GM, Toyota, and Nissan are all in a race to develop the first successful mass-market PEV, with expected release dates from 2010 to 2011. The momentum is shifting from producing boutique, aftermarket solutions such as conversion kits to producing cars with mass-market appeal. However, in order to achieve high-volume sales of plug-ins, the cars not only must have easy-to-use, reliable technology but also must sell at a price that most customers can afford.

Recent advances in battery technology have allowed for the development cycle of PEVs to be shorter than that of new car models. For example, new lithium-ion batteries are much lighter than they used to be. For an equivalent charge, today's batteries are about one-quarter as heavy as they were ten years ago. But the unique specifications for electric vehicle batteries require extensive research and testing to ensure that they are stable and perform consistently before they are mass produced. The pace of current battery technology development suggests that they will be ready for the market in the near term, and as long as PEVs are produced on a large scale with readily available materials, their cost is certain to

decline. Meanwhile, manufacturers are understandably cautious about selling cars with batteries that add several thousand dollars to the sales price and whose performance is uncertain.

An Opportunity for Electric Utilities

While car companies fret over the cost of batteries, electric utilities are uniquely poised to benefit from a U.S. vehicle fleet with a greater number of PEVs. By fueling a significant portion of national transport, electric utilities could become, in the words of GM spokesman Robert Peterson, "more important than the oil companies."[2] PEVs not only would provide the utilities with a large new source of energy sales, they also would serve as a potential resource for helping to manage the grid. If PEVs incorporate emerging vehicle-to-grid (V2G) technology for grid and load management, they will help reduce the chance that electric utilities will have to invest in increasingly expensive generation assets. There is even discussion of having utilities use old PEV batteries after they are retired from vehicles for some stationary grid applications.

The efforts currently under way are helping to create a market for PEVs, but to further accelerate their widespread introduction in a way that benefits utilities, car manufacturers, and customers, it may be useful to create a program to directly offset the added costs and risks of the batteries used in the cars. Performance issues can be addressed through warranties, but the question remains of how these new vehicles can achieve price parity with hybrids and even internal-combustion cars.

A rate-base approach by electric utilities could be the answer. The basic idea is that the utilities would own the PEV batteries sold in their area and treat them as their own assets, much as they do with generation, transmission, and distribution infrastructure. They would lease the battery to the car owner, thus offsetting the incremental battery cost at the time of the purchase of the vehicle, and utilities would recover the added cost through utility rates.

Here's how it could work. When a PEV with an integral, manufacturer-installed battery is purchased, the battery is seamlessly, automatically, and simultaneously sold to the local electric distribution utility. The vehicle's sticker price would not include cost of the battery—or perhaps more accurately, it would already reflect the battery lease payments. The

battery lease would be integrated into the sales price of the car; the only difference to the customer would be the reduction in the sticker price due to the electric utility's ownership of the battery. The battery would be the utility's property, and the customer would automatically become the battery lessee until the car was sold or destroyed. The utility would amortize the battery investment through a small surcharge on distribution rates. If the car is resold, the battery lease would transfer to the new owner. The battery of a car that is retired would be removed for load-balancing by the utility, or the manufacturer would remove and retire or recycle the battery, just as today.

The program would be needed only for the first five to ten years of PEV sales, its duration perhaps linked explicitly to the number of vehicles sold (say, the first million or two million PEVs). After that, production volume and manufacturing cost savings should reduce costs to the point that much less support would be needed. A similarly structured program is being used for current hybrids: tax incentives are offered for the first 60,000 hybrids sold by a particular manufacturer and then slowly phased out. The incentives, not including the phase-out period, cover roughly 300,000 hybrids. More ambitious incentives for PEVs with more ambitious sales targets would likely increase initial demand.

During the initial market introduction phase, the cost of the batteries would be recovered by utilities through electricity rates. The program would be in effect while PEV sales were in their infancy and discontinued once sales reached full commercial scale. Conservatively assuming that each battery cost $3,600 and had an average vehicular service life of five years, the annual carrying cost for the utility would be about $902 per battery.[3] If, starting in 2010, PEV sales were to follow a trajectory similar to that of hybrid electric vehicle sales, then there could be a 0.2 percent fleet penetration of about 500,000 vehicles (or just over 0.4 percent of households with PEVs) within five years of the start of commercial sales (see table 13-1).

Spreading the cost of the batteries across all electric customers, at a half-million vehicles in cumulative sales, battery cost recovery would increase the average residential customer bill by just 7 cents a month, or 84 cents a year. By the time there were 2 million PEVs in cumulative sales (just under 1 percent of the light-duty vehicle fleet), the goal of accelerating PEV battery technology to commercial production levels would be

Table 13-1. Estimated PEV Sales and Program Costs, 2015 and 2020

Item	*2015*	*2020*
Additional cost of battery (assumed)	$3,600 per vehicle	
$902 per vehicle-year (five years)	$3,600 per vehicle	
Total number of subsidized PEVs (cumulative since 2010)	0.5 million	2.4 million
LDV fleet penetration (total)	0.2 percent	0.9 percent
Total cost for battery program	$0.29 billion	$1.41 billion
Annual cost per residential electric customer	$0.84	$3.92
Percentage increase to average residential electric utility bill	0.1 percent	0.3 percent

achieved. The first-cost barrier to introducing PEVs to consumers would be reduced immensely, and PEVs could compete on a level playing field with traditional internal-combustion vehicles as well as vehicles using alternative technologies. At that level, where the subsidies are largest, the impact on the average residential electricity bill would be about 33 cents a month, or $3.92 a year.

The lease arrangement with the local electric utility would leave the choice of battery, warranty, and other terms undisturbed. Car and battery manufacturers would come to their own commercial terms regarding performance guarantees, warranties, and service agreements. Car owners would be entitled to the same protection that they would have if they owned the battery, and utilities would be in the business of providing electricity, not guaranteeing car parts. In order to make the process as seamless as possible, every segment of the electric power industry should be able to participate in the program, from investor-owned utilities to cooperatives to municipal utilities. Furthermore, commercial or utility fleets should be able to opt out of the program.

Of course, a large portion of the initial cost would be due to ongoing development of batteries that can carry a sufficient charge for the vehicles, particularly if they rely wholly on electric power. The program would require that the leasing arrangements be made regardless of battery technology. Thus the program allows for continued innovation because the relationship between the car and battery manufacturers would be independent of the leasing program. Car manufacturers would still have the same incentive to incorporate the most innovative, cost-effective technology in their cars.

Cooperation between State and Federal Government Agencies and Electric Utilities

Admittedly, the proposal does not present what is a traditional business model for the electricity sector. Utilities are used to having fixed assets that have well-known operational lives, amortization schedules, and project finance strategies. When similar ideas have been raised in the past, there has been resistance on the part of utilities to having assets that move around between areas and states for fear that their assets may not even be used by their own customers and grids. But electric utilities are on the brink of entering the transportation sector, and they will benefit in the long run by taking an active role at the outset. If managed correctly and with sufficient collaboration between regulators and utilities, transfers from one service area to another could be imperceptible to both utility and car owner.

There are several advantages to having electric utilities own the batteries. Utilities have a low cost of capital and the ability to amortize the incremental first costs over a large sales base. In addition, it is the electric utilities whose sales will benefit from PEV growth, and they will have the best resources available to measure PEVs' impact on electricity infrastructure. It is highly likely that the batteries are going to be a part of the nation's electric power grid, either through residual battery use for load management or through more advanced V2G technology. Utilities not only are poised to profit from electric drive vehicles by providing the fuel, they also are the best entities to promote off-peak battery charging, to ensure user safety, and to institute pilot projects for V2G and residual use programs.

Ideally, the proposed program should be implemented nationally and with the participation of state and federal government and regulatory agencies, giving the utilities regulatory support for tracking changes in ownership. After a PEV was sold, the battery would be linked to the location where the car was garaged (that is, the owner's location) for insurance purposes. If the car changed ownership within the service area of the same distribution utility, that utility would not have to make any changes. If the car was moved to a location outside the original service area, the asset should shift to the new local distribution utility's rate base.

Initially, owning and managing batteries may be seen as being beyond the core capabilities of most utilities, requiring them to take on a new set of administrative responsibilities. There are a variety of ways in which the

industry could pool and greatly reduce its administrative burdens, thereby allaying fears that each individual utility would be responsible for tracking batteries in its service area. One alternative is to create a dedicated public-private acquisition and leasing corporation that acquires the batteries and administers the program for all utilities, allowing utilities to invest in the corporation rather than the batteries themselves. The newly established national corporation, designed with the input of electric utilities and subject to federal oversight, would be able to administer battery tracking through a single central database. Each utility would contribute capital to the corporation, and its investment would be put into the rate base for all utilities, allowing them to recoup their investments through rates (with a reasonable return on investment, as for other capital assets). In turn, program administration would be centralized, allowing for tracking of battery sales and vehicle life.

The federal government also could administer a PEV battery ownership program simply by creating a fund to subsidize the cost of the battery to the PEV buyer or by giving grants or tax credits directly to buyers or automakers. However, such a program would typically require significant taxpayer funding; without it, the first-cost barrier would remain large.

Regardless of whether the battery ownership or public-private corporation approach is adopted, the role of the federal government would be to ensure national participation in the program. All utilities would have to participate in order to allow customers to take advantage of it anywhere in the United States. If utility participation was not universal, the automatic battery buy-down/lease could be offered only to cars in certain areas. If federal policymakers wanted to make the program universal, it would be easy to legislate a federal surcharge on power distribution rates and fund the public-private leasing corporation that way. Under that approach, there would be no rate-basing of the batteries and local utilities would be just collection agents.

Federal measures would have to be in place to help standardize the financial structure of the program. Utilities would definitely want—and should receive—legislative assurances that they could amortize the costs. Such assurances have been provided to utilities for other purposes in the past.

All of these approaches would be reasonable if they were implemented wisely. However, many citizens frown on direct federal subsidies to retail purchases, and the federal government would be in the difficult position

of justifying a battery ownership program to the wider public. Utilities have the means to raise capital for battery purchases, and they have a well-tested framework for recouping their investments. If the federal government cannot afford to remove the first-cost barrier, then utilities are the next logical choice.

Nearly every president, all former secretaries of energy, and many congressional leaders have pledged at one time or another to reduce or end U.S. dependence on foreign oil. These approaches—utility battery ownership or a federally administered public-private corporation—can deliver on that perennial promise. At the same time, either approach would prepare utilities to be a vital part of the national transportation infrastructure.

Plug-ins are a crucial part of the solution to rising emissions and overdependence on oil. Battery costs are the main barrier to broad-scale deployment of PEVs. Every possible acceleration strategy should be put to work, but utilities alone have the customers, synergies, and balance sheets needed to help get the cars on the road as soon as possible.

Notes

1. In this chapter, the term *plug-in electric vehicle* (PEV) encompasses both fully electric and plug-in hybrid electric vehicles (PHEVs).

2. Rebecca Smith, "Utilities, Plug-In Cars: Near Collision? Electric Firms Say Daytime Charges May Raise Costs," *Wall Street Journal*, May 2, 2008, p. B1.

3. The estimate for vehicular service life takes into account predicted battery calendar life and deterioration due to regular charging and discharging. A uniform cost per battery of $3,600 is assumed for both all-electric and hybrid-electric vehicles, although the former would likely house larger batteries.