

Cool New Plug-In Hybrids • Treating Stressed Soldiers

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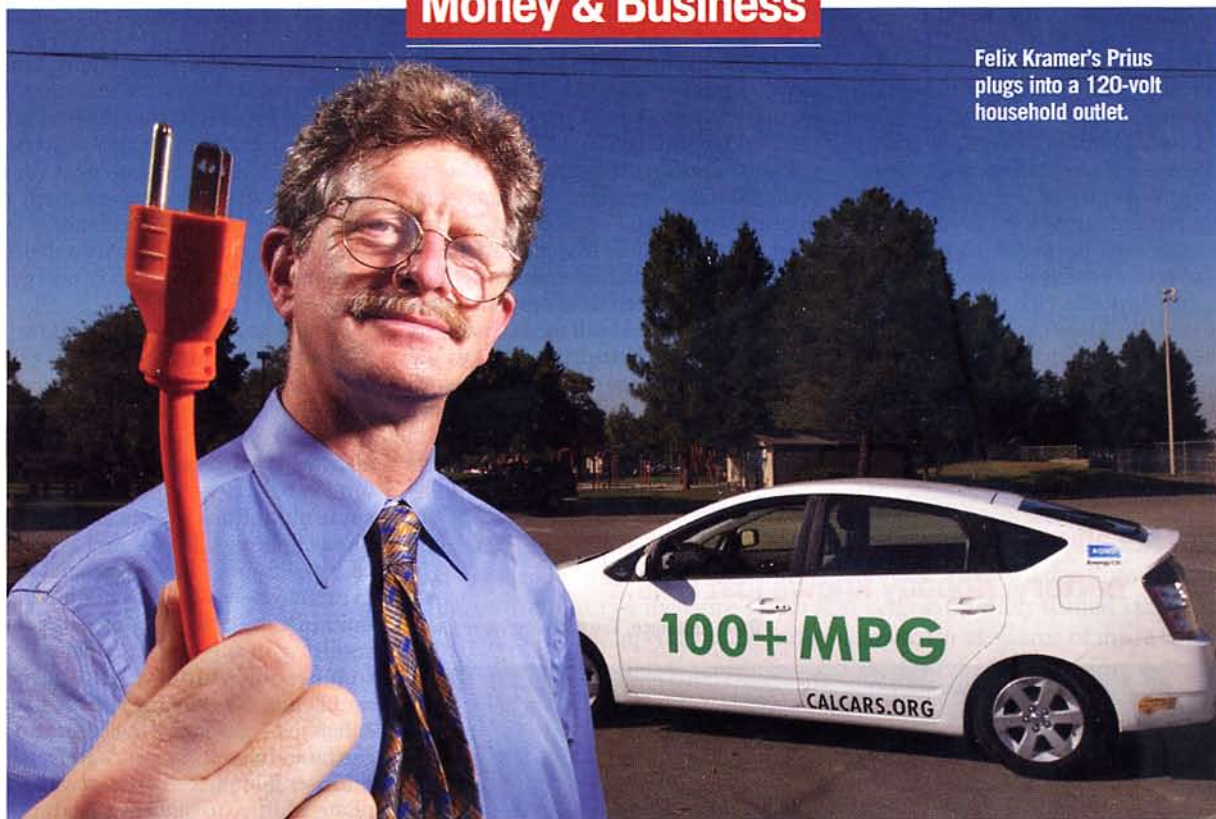


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CalCars
THE CALIFORNIA
CARS INITIATIVE

Felix Kramer's Prius plugs into a 120-volt household outlet.



A PLUG FOR HYBRIDS

100-mpg prototypes are on the road. Needed: safe, cheap batteries

By Marianne Lavelle

When Andy Frank first tried to demonstrate how electricity could help a car get 100 miles per gallon of gasoline, he resorted to the only big power source he could find, the lead acid battery from a Caterpillar tractor. But the farm vehicle-to-auto transplant didn't work, and the young professor concluded the battery technology of 1972 wasn't up to the job. Still, he didn't give up. "This is fundamental engineering," he says. "If you do the physics and calculations, and have the knowledge of how cars work, you can show on paper it's possible."

Thirty-four years later, Frank's dream, known by its cadre of advocates as the "plug-in hybrid electric vehicle," is tantalizingly close to reality. Daimler-Chrysler has research vehicles on the road, Toyota this summer became the first car company to announce it was working on a commercial PHEV, and the other automakers—while not making commitments—are no longer scoffing. Big money also is taking notice, with legendary venture capitalist John Doerr calling plug-ins "a really big deal" and the philanthropic arm of Google apparently poised to back research.

Like the Toyota Prius, the new hybrids would draw power from either the electric battery or the gasoline engine. But they would have bigger, more powerful batteries—and a cord that would plug into a normal 120-volt household outlet. They would be able to travel long distances, perhaps 20 to 40 miles, using little or no gasoline. Since the vast majority of Americans drive fewer than 40 miles per day, the PHEV could render the daily commute gas free. And the driver would never be stranded without a charge. PHEVs are "the most immediate and practical alternative to petroleum and represent a bridge technology to a sustainable transportation future," says Kateri Callahan, president of the Alliance to Save Energy, a coalition of environmental and business groups.

That's not to say there aren't major stumbling blocks, namely the batteries. Automakers say no one yet has made an energy storage device strong, safe, and cheap enough to install in a mass-market auto. However, PHEV advocates argue that exactly what is needed to drive electric battery technology forward is a bold decision to put such vehicles into demonstration fleets. "The research essentially has been done," says Frank, who leads the hybrid electric vehicle group at the University of California-Davis—a project he calls Team Fate, after the driven professor in the 1965



film *The Great Race*. "What we need is the development—putting it into high-volume production."

To prove demand exists, a group called Plug-in Partners, led by the city of Austin and its power company, Austin Energy, has organized local governments and businesses to pledge to buy hundreds of PHEV vehicles—even at a bloated early-adopter price—if carmakers would only build them.

Then there are the activist tinkerers, who strip the batteries of their current hybrids and replace them with perfectly viable—albeit expensive—big plug-in batteries. EVWorld.com recently told

"For us, conversions are entirely a strategy to increase interest, to encourage carmakers to do what they do best with the best technology."

Perhaps understandably, electric power companies have emerged as strong plug-in promoters, with Pacific Gas & Electric even including fliers in September bills asking its 5.1 million customers to petition automakers to speed development. Utilities obviously would sell more electricity if people plugged in to drive. But it would also allow them to make use of their enormous stores of off-peak capacity. Industry studies say if millions of plug-ins took to the road tomorrow, no new power plants

recent congressional testimony, Honda's environmental analysis manager, John German, estimated that the fuel savings over the life of the vehicle would be only \$3,000. "There is no business case unless fuel prices rise to substantially more than \$3 per gallon, fuel shortages occur, plug-in hybrids are heavily subsidized, or there is a breakthrough in energy storage," he said.

Burning issue. Big batteries add weight, decreasing performance. Most experts, both inside and outside the auto industry, agree that carmakers will turn away from the nickel metal hydride batteries now in all hybrids to lighter, more powerful lithium ion batteries—the kind that have become ubiquitous in consumer products like cellphones, iPods, and laptops. Of course, lithium ion batteries made news in recent weeks when the malfunctioning units in some laptops erupted into flames, resulting in the largest consumer electronic recall in history. PHEV advocates, noting that cars already tote an explosive substance—gasoline—insist safety issues can be addressed. Kramer's converted hybrid uses lithium ion batteries with a phosphate additive to quell overheating.

But Toyota executive engineer David Hermance says the bar is high for automakers. "I guarantee the battery's not ready," he says. "We won't bring a product to market unless it meets our internal durability and reliability tests." That's why Toyota has given no timeline on introduction of a plug-in hybrid. "It's generally regarded as inevitable that we will get a better battery," he says. "Nobody knows just when."

Plug-in activists are looking outside the auto industry for help. Especially encouraging was the move by Silicon Valley venture capital firm Kleiner, Perkins, Caufield & Byers to double its commitment to green technology investments to \$200 million over the next two years. And the plug-in world is abuzz with rumors that Google.org, the for-profit philanthropic arm of Google, is poised to help, though the company will say little.

Despite the challenges of bringing plug-ins to market, energy experts say the concept has advantages over almost any other alternative now contemplated, including using hydrogen as a fuel. Andy Frank, meanwhile, continues to plug away. "The difficulty is convincing the automotive industry to transition from where we are today, with the products in use today, to this new utopia, without having to introduce additional infrastructure," he says. "In our case, the infrastructure is the plug in the wall and the gas station." ●

"It's generally regarded as inevitable that we will get a better battery. Nobody knows just when."

David Hermance, Toyota executive engineer



Kramer's converted hybrid uses lithium ion batteries with an additive to quell overheating.

readers the switch can be done "if you have significant skills in electromechanical assembly and a cavalier attitude toward your Prius warranty." At least a dozen home-baked plug-ins journey U.S. roads today, achieving the golden century mark in gas mileage, their owners say. With the help of Monrovia, Calif., research firm EnergyCS, Felix Kramer, founder of the California Cars Initiative, took to the road with his prototype in April. On one recent stretch, he drove 949.75 miles on 9.36 gallons of gasoline. That's 101.5 miles per gallon. (New York Gov. George Pataki is so enthusiastic he has allocated \$10 million to convert 600 Priuses already in the state fleet to plug-ins.) "It's just a stunt," Kramer concedes.

would be needed. A plug-in would draw energy equivalent to that of an electric space heater. While the consumer would pay more for electricity, it would be more than offset by the savings for gasoline, even if pump prices dropped far below those of today. At today's prices, a driver would pay 94 cents to the power company to drive 30 miles on plug-in power. To drive the same distance in the average U.S. car would cost \$2.58 at the pump. But automakers are not convinced that 64 percent savings in fuel costs will offset the initial cost of the battery. Kramer's conversion cost \$12,000, in addition to the \$21,000 cost of the original Prius. He maintains that the battery cost could be driven down to \$3,000 if it were mass produced. But in