

## Plugging Into the Future

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I drove to work one day last week in a prototype car that is either a harbinger of a far more fuel-efficient future, or another in a long line of technological insurgencies that will fail in the end to crack the auto industry's century-old status quo.

The car was a Toyota Prius modified, by the addition of a 72.5 kilogram (160 pound) lithium-ion battery pack, into a so-called plug-in hybrid capable of operating for as many as 40 miles almost entirely on electric power alone. The battery pack is a product of Massachusetts-based A123 Systems (<http://www.a123systems.com/1>) and its recently acquired Hymotion Inc. subsidiary.

Here's how my drive to work went. I walked out of the house to where the Prius was parked, close enough to my garage so that I could run an extension cord from the wall outlet to a three-prong plug installed in the car's rear bumper.

I'd plugged in the car the night before, and by morning the lithium-ion batteries installed in the trunk were charged up. I stuck a plastic key fob into a slot in the dash, hit the "Power" button -- and then hit it again, because I couldn't tell if the car was on. There was no engine noise.

Once I had the on-off business sorted out, I put the car in drive and silently rolled out into the street. And I continued to roll on electric power. In a normal Prius, the gasoline engine kicks in once you get past walking speed. In this car, the extra batteries allowed me to keep rolling in electric-only mode at highway speeds. The company estimates the electricity cost of an overnight charge to be around 75 cents for 50 extra miles.

As I dodged fellow citizens in their last-century gas-only SUVs, I snuck glances at the Prius's information screen, which displayed my fuel consumption and the flow of power from the batteries and the gasoline engine. For most of my roughly 20-mile trip to the office, I appeared to be on electric-only power. Accelerating to merge with traffic, and avoid becoming a high-tech oil spot under a semi, I engaged the gasoline motor. But cruising was all-electric -- and according to the Prius's on board fuel consumption computer, I was cruising at 100 miles to the gallon. The only awareness I had of the power generation hand-offs between the gas engine and the lithium-ion batteries, or the lithium-ion batteries and the Prius's factory-installed nickel-metal hydride battery system was the videogame display in the dashboard screen.

My reaction to this experience, drawing on 20 years of covering the auto business, was: "Wow! Who wouldn't want this?"

It's the questions that come next that have been a problem for the auto industry: What does it really cost? Is it reliable? What about the warranty? (Toyota's stance on that last question is that anyone who modifies the Prius into a plug-in voids the warranty.)

Not so long ago, it looked as though the industry's big dogs weren't confident they had good answers for those questions in the near term. Electric cars have foundered since the industry's earliest days on the rocks of cost, reliability and range. Plug-ins have range, but with current battery technology they didn't appear to have mass-market levels of cost or reliability.

GM earlier this year made a splash with a prototype of a plug-in called the Chevrolet Volt -- but stressed that the batteries to make the Volt real hadn't been invented yet. Skeptics, me included, wondered where was the beef?

Lithium-ion battery technology can handle the cycles of charging and discharging required for a plug-in better than nickel-metal hydride batteries. It's used now in small power tools and laptops. But lithium-ion battery also has what's referred to as "heat management" issues. That means fire, Scarecrow. The recent spate of publicity about lithium-ion laptop batteries bursting into flame has only made resolving this issue more urgent.

The A123 Prius conversion kit is just one sign of the increasing optimism within the automotive and enviro-tech communities that the battery technology required to deliver a reliable plug-in or electric vehicle could be ready sooner than once thought. Last week, about 30 groups entered the Automotive X Prize competition, which plans to offer a multimillion dollar reward to entrants who can build a marketable, 100 mile-per-gallon car and compete in races scheduled for 2009. Meanwhile, several companies, such as Tesla Motors of California, are drumming up interest in electric vehicles.

Tony Posawatz, the vehicle line director for GM's plug-in hybrid Chevrolet Volt and other vehicles using GM's E-Flex electric-vehicle technology, says he expects to get battery packs by the end of this year from suppliers who believe they have what it takes to meet GM's criteria for a safe, reliable and cost-effective plug-in hybrid. A123 is part of one group along with Continental AG. Another involves big Korean battery maker LG Chem.

"We are encouraged," Mr. Posawatz says of the developments in battery technology. GM is still aiming to have a production version of the Volt ready to roll by late 2010, provided the batteries are ready, too, he says. GM has also said it wants to make a plug-in version of its Saturn VUE compact SUV.

Mr. Posawatz won't say the Volt by 2010 is now a sure thing, but with a telephonic wink to the naysayers, he says developments such as the A123 Prius conversion system are "indicators telling you that from a technological perspective it's not that far off."

Toyota, meanwhile, earlier this month took another step closer to the plug-in camp by announcing it will start offering prototype plug-in Priuses for testing in the U.S. and Japan. Plug-in advocates will say, we told you so. While GM and Toyota ramp up their rival plug-in programs, consumers will get a chance to vote with their wallets on whether plug-in technology makes sense.

Ric Fulop, an A123 founder and vice president of marketing and business development, says his company is on track to offer by early next year lithium-ion plug-in conversion systems similar to the one I tested to Toyota Prius owners and hybrid Ford Escape owners. Initial numbers will be relatively low, he said. "If we sold 1,000 next year that's a big start."

Prices aren't set yet, but it's likely a system that can extend the electric-only range of a Prius by 40 miles will cost about \$10,000. A 20-mile system will cost about half that, he says. The company is working to get tax breaks to offset those costs, and Mr. Fulop says A123 is trying to convince Toyota to ease the hostile stand on warranty coverage. (A Toyota spokeswoman says she's unaware of any discussions on the issue.)

As for the Volt, Mr. Fulop says, "it totally can happen."