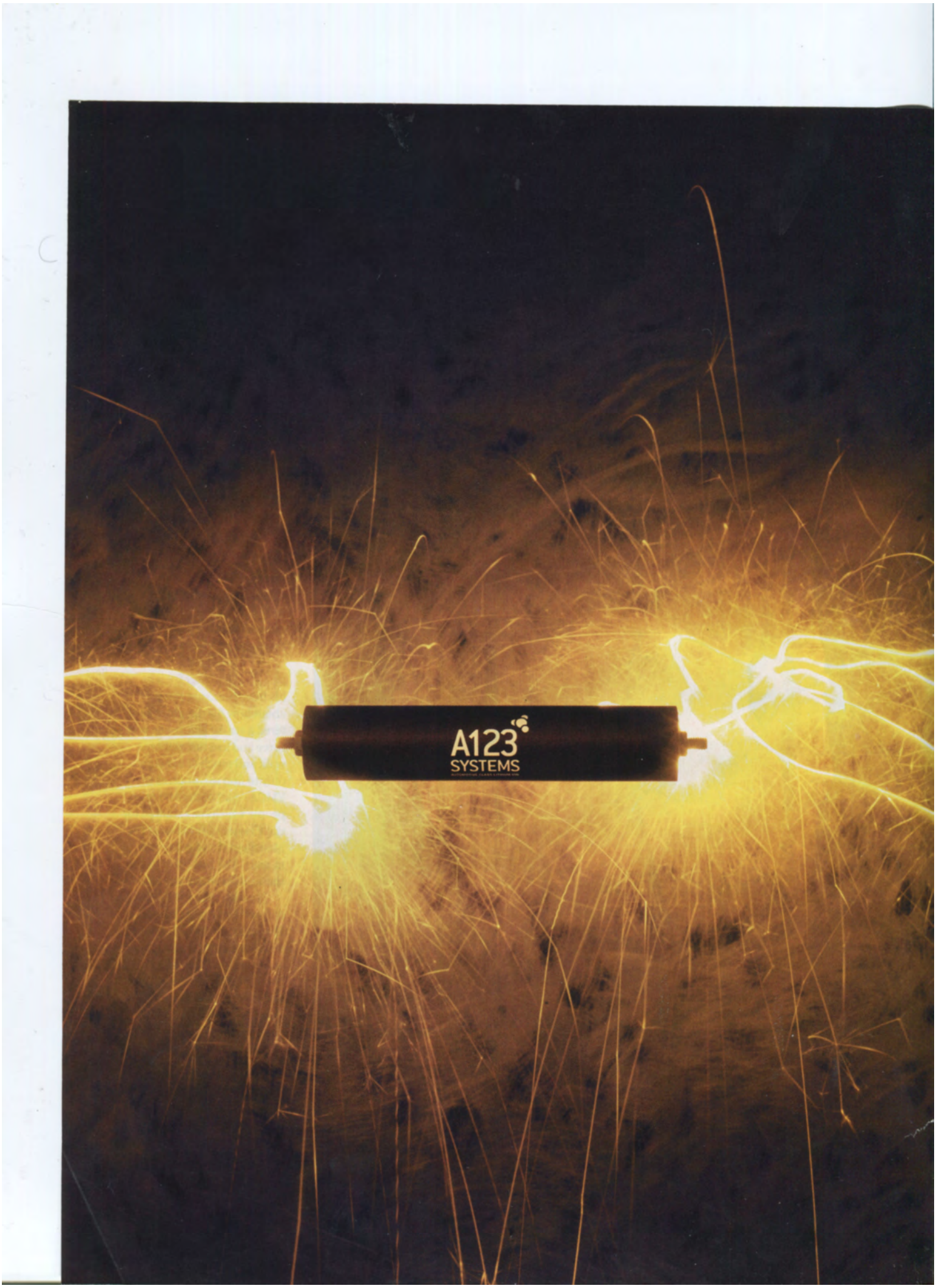

A123
SYSTEMS

Watertown's A123 Systems makes batteries. Very special, high-tech batteries. Batteries that could boost the state economy, rescue the American auto industry, change the way we drive, and save the environment in the bargain.*

***That is, if the competition doesn't beat them to it.**

Supercharged

By John Sedgwick
Photographs by White/Packert

Opposite, A123's ANR26650M1 battery.

Close up, it is a rather homely thing, looking like an aluminum-plated penny roll, only smaller. But hold it in your hand, and it has a density, a heft, that suggests more. What it is, in fact, is a battery. And as we will see, it is anything but humble. ¶ A123 Systems, the Watertown firm that makes the battery, labels it the ANR26650M1. What you need to know is that it is rechargeable, and composed of lithium ions that buzz back and forth at mind-boggling speeds. With such a dizzying rate of oscillation comes exceptional power. And when these supercharged batteries—or cells, to use the proper term—are packed together, the effect is explosive. Enough to send an electric motorcycle called the KillaCycle from zero to 60 in 1.04 seconds, breaking the world record for an electrical vehicle when it topped out at nearly 157 mph. (You should see the video. Seriously: bostonmagazine.com/killacycle.) Enough to send a full-grown soldier holding a rope ascender shooting 100 feet up a wall in just 10 seconds. ¶ But those are mere stunts. The real job of these little babies is to save the planet.

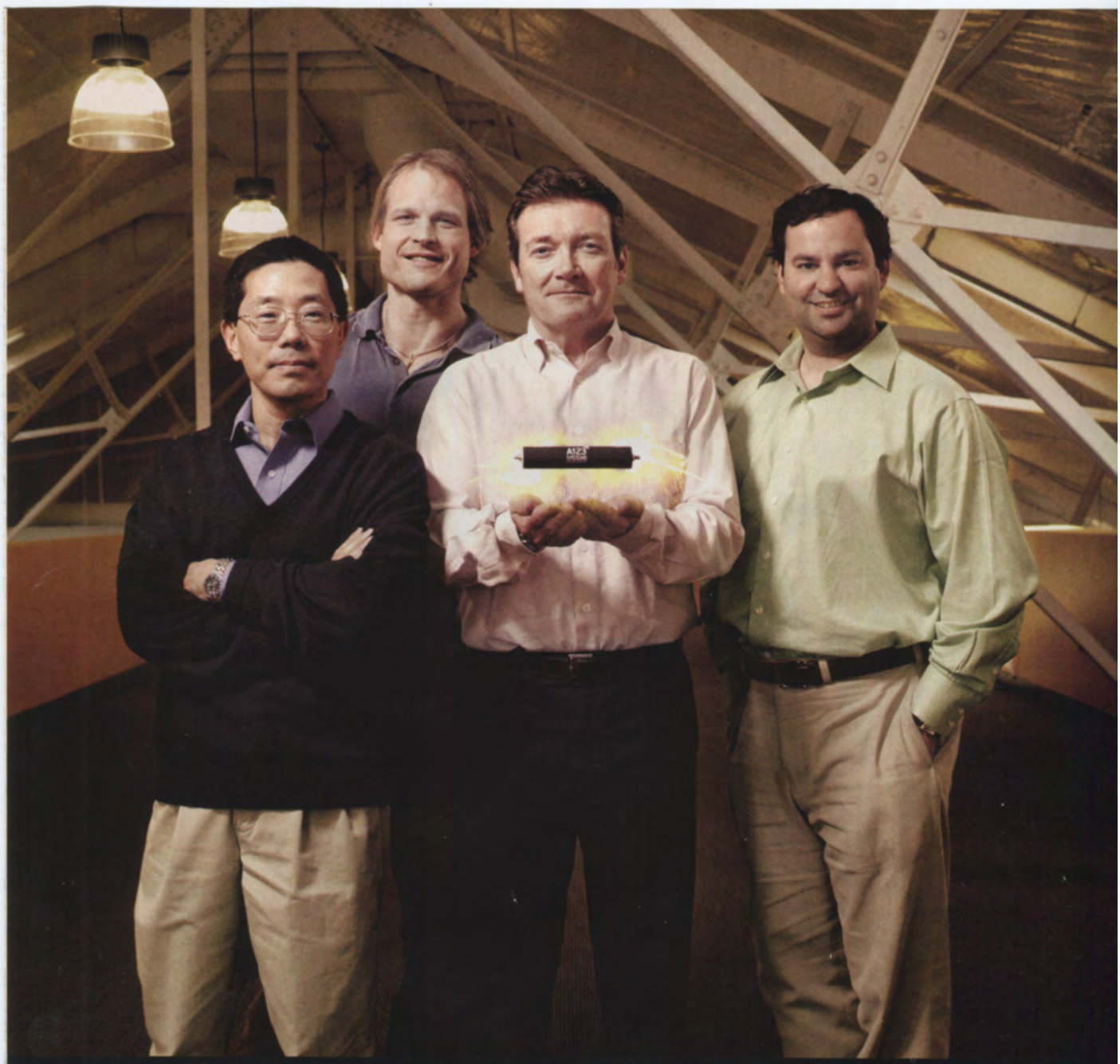
You wouldn't think it would all come down to batteries, but you'd be wrong. The battle to preserve our environment is being fought on two fronts: the generations-old attempt to reduce the sulfur dioxide and other pollutants that produce the acid rain that dissolves our cities and kills our ponds, and the newer, highly publicized efforts (à la Al Gore) to control carbon emissions, the much maligned culprit behind the greenhouse effect. With their potential for storing and, subsequently, putting out cleaner power, batteries—specifically, rechargeable batteries—are key to progress in both arenas. "Batteries," says professor Henry Jacoby of MIT's Center for Energy and Environmental Policy Research, "are a big deal." Just in case he hasn't been clear, he says it again. "They are a *big deal*."

By increasing the effectiveness of renewable-energy sources, these next-generation batteries can make them all the more widely used. Those Cape Wind turbines Deval Patrick made such a fuss about during his gubernatorial campaign? They'd become that much more attractive if they could still give off power when the wind wasn't blowing—say, from reserves stored in a massive cluster of A123's batteries. Same goes for those solar panels glinting off Cambridge rooftops: By pushing the expected life of energy storage systems from four years to 15 or higher, such a battery could represent a windfall of energy savings for the homeowner—a further inducement (beyond altruism) to the budding planet-saver contemplating a switch to renewables.

What's more, by reinforcing the electric end of hybrid car engines, lithium-ion batteries like the ANR26650M1 might someday expel the gasoline-powered car altogether. And *that* would be a big deal. As well as big money for whoever gets there first.

IT WAS 2000, AND YET-MING CHIANG WAS working away in his MIT laboratory with various compounds and materials he hoped might one day improve a battery's storage capacity. At one point in his tinkering, he hit upon something promising. A career MIT-er (a freshman in 1976, he's now a material-sciences professor at the school), Chiang had been studying batteries for over a decade. But this, he'd never seen: When phosphates were reduced down to the nano level—way, way down, that is—they exhibited what scientists call a "special functionality." Chiefly, they made the ions that produce a battery's energy more powerful. Extraordinarily so.

To fully appreciate Chiang's discovery would require an engineering degree. But a glimpse of its genius requires only a rudimentary understanding of how batteries operate. Basically, a battery puts out energy when its ions shift between magnetic poles. Moving from the negative pole to the positive, the ions discharge energy; when they change directions—from positive to negative—they recharge. When Chiang introduced nanophosphates to the positive pole of the battery, the lithium ions started agitating like crazy. With millions of ions zooming back and forth, from pole to pole, at five times the usual speed, the power output increased fivefold over regular old lithium cobalt oxide cells—



If their calculations are correct, A123 principals, from left, Yet-Ming Chiang, Bart Riley, David Vieau, and Ric Fulop have a revolutionary product on their hands.

the existing standard for rechargeables. It also lasted 10 times as long.

So Chiang was on to something. To take his breakthrough from the lab to the assembly line, though, required an investor with ready access to capital and a high tolerance for risk. That's where Ric Fulop came in. Raised in Venezuela, Fulop had finished high school at age 16, using his bar mitzvah savings to start a software distribution company that soon was pulling in $1 million a year. A few years later, the young entrepreneur sold the firm and moved to Boston with every intention of earning a business degree from Babson. But the allure of getting in on the next big thing got the better of him, and he left college to start another business—this time, a broadband and network company. Once again, he rode the wave to success.

By 2001, the 26-year-old entrepreneur was sniffing around energy storage, where he suspected he'd find his *next* next big thing. He had plenty of cash and an eye for promising technology; what he didn't have was an idea that knocked his socks off. In July 2001, Fulop stopped in to see Jack Turner, associate director of the Technology Licensing Office at MIT. (No surprise there: The TLO gets a lot of foot traffic; last fiscal year alone, MIT made $43 million in licensing fees and royalties.) Turner directed Fulop to Chiang's lab, where, Turner had heard, something "interesting" was going on—MIT-speak for CONTINUED ON PAGE 175

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"Get over there." Fulop did and, after meeting Chiang, was immediately taken with the scientist's work. In typical fashion, Fulop began fantasizing aloud about a business plan that would exploit the idea.

Fulop had ample reason to believe the technology could be useful, not to mention highly lucrative. For starters, factories and transportation companies that operate high-polluting equipment—the fire-breathing monsters that belch out carbon, sulfur, and all manner of airborne toxins—might have a lot of interest in a battery of this caliber. Enormous machinery requires an enormous amount of power, particularly to get it going; if that power could be provided by an electric battery, even partially, the potential green benefits would be huge. (Indeed, A123 batteries are now used to give the turbines of jet planes those first few cranks to get them started.) What's more, the durability of Chiang's batteries made them cost-effective—unlike a lot of green energy—and their compact size made them versatile. Then, of course, there was that pesky problem faced by standard batteries: flammability. The oxygen released by damaged lithium cobalt oxide batteries causes them to catch fire if they encounter a spark. (Remember all the Dell, Apple, and Hewlett-Packard laptops that got recalled a while back? That was lithium cobalt oxide—in action.) Nanophosphate lithium ions, by contrast, do not release oxygen, which means that a battery made from them is virtually fireproof. When Fulop factored all that in, the potential market looked wide, and largely untapped.

"In the battery field, it's far easier to have an interesting idea than a useful one," says A123 cofounder Yet-Ming Chiang.

As Chiang remembers it today, his first reaction was to approach Fulop's proposition with caution. "We have a saying in the battery field," he says. "'It is far easier to have an interesting idea than it is to have a useful one.'" But Fulop's enthusiasm was infectious. Less than six months later, A123 was up and running.

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When it later moved into Watertown's Arsenal on the Charles, it secured a headquarters with an auspicious past—the space had once served as the complex's power station.

A123 SYSTEMS GOT SOME HELP FROM high places in getting off the ground: The federal Department of Energy put in $100,000 in seed money, and, once the company was in gear, kicked in another $7.5 million in a matching grant to push it further along. That money, valuable in itself, proved critical in establishing the company's legitimacy. As the Patrick administration is demonstrating with biotech, government has a role to play in the creation of homegrown startups like A123—and, perhaps more important, in encouraging them to stick around.

Along with biotech, renewable energy has been targeted by Patrick as one of the key growth industries in the state. Bolstered by the DOE's seal of approval, A123 was able to beat the bushes for some serious private backing, accumulating more than $100 million from such financial powerhouses as GE, Procter & Gamble, and fabled Silicon Valley venture-capital firm Sequoia. That backing paid off in 2003, when A123 was tapped by Black & Decker to supply the batteries for its high-end DeWalt power tools. "With our batteries, you get more power out of the cordless version than out of the corded version," says Joseph Adiletta, a product manager for A123. "Basically, it means you can do everything faster."

Priuses outfitted with A123 batteries drastically outpace standard models, jumping from 45 to a staggering 150 mpg.

It's the automotive industry, though, that remains the big enchilada. A123 has already cornered one portion of what's still considered a niche market, having teamed up with Michigan-based Cobasys to win a contract to provide batteries for General Motors' new Saturn Vue. It's one of more than 15 hybrid vehicles, including a Cadillac, a Lexus, and a Toyota minivan, that are now being designed as "plug-ins." Drawing the extra electrical power from garage

wall sockets at night—when electricity rates are low—a hybrid plug-in can reduce overall emissions by half, and gas consumption by 60 percent, according to published estimates.

At higher speeds, a hybrid like the Toyota Prius motors along on fossil fuel—the optimal setup for that driving situation. It's only at lower speeds that it switches over to electric power. But even then, its battery holds only

By the standards of startups like it, A123 Systems went from concept to product launch in lightning speed.

two to three miles of juice; once it runs out, the gas kicks back in—both to keep the car moving, and to recharge the battery—significantly cutting into any improvements in fuel economy. When that battery is supplemented by long-lasting A123 batteries tucked away in the spare-tire well, however, the car can run much farther on electricity alone, yielding tremendous gains in efficiency. The Priuses that A123 has outfitted with its batteries drastically outpace the standard models, jumping from 45 mpg to as much as a staggering 150 on a typical 40-mile commute. For a car with a 15-gallon tank, that could mean filling up every 2,250 miles—or just four or five times a year.

Car designers are even more excited by the prospect of an *all*-electric car, which would allow them to bring a more Buck Rogers sensibility to their designs. Because such a vehicle could be operated by electrical impulses rather than by mechanical controls, engineers have dreamed up vehicles whose brakes, gas pedal, and steering wheel wouldn't need any physical connection to the actions they produce. The brakes might, for example, be located on the steering wheel itself—much like the levers on a bike. Speed could be controlled by rotating a handgrip, as on a motorcycle. The steering wheel might be freely detachable so that an Englishman, say, could drive on the right side of the car in London, and then slide the steering wheel over to the left side to motor about in northern France—a true cosmopolite's dream.

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with movable parts? The entire body of the car might be made detachable from the underlying chassis. Need a minivan to take all your kids' friends to soccer practice? Just pop over to the neighborhood dealership, snap off the sedan top, and drop in the minivan module. With the driving controls independent, space would be cleared for a nearly floor-to-ceiling windshield, allowing front passengers to actually see the road beneath their feet.

The A123 battery–powered KillaCycle set a world speed record.

Fantastic as it all sounds, such *Back to the Future* trappings are already operational in an all-electric GM test vehicle called the Hy-wire. Unveiled in 2003, it runs by converting hydrogen to electricity—don't ask how—but the outcome is the same. Don't expect to drive a Hy-wire anytime soon, though. There is only one, total, and it costs nearly 10 million bucks.

BY THE STANDARDS OF MOST STARTUPS of its kind, A123 Systems went from concept to product launch in lightning speed—its batteries were in Black & Decker power tools in less than six years. David Vieau, A123's president and CEO, is more than happy to rattle off the factors that have aligned so nicely for the company: The once-fringe green movement has now flowered into a near universal monomania; the Iraq war, along with political unrest in other oil-producing countries, has inspired abundant anxieties about potential oil shortages even as oil prices continue their rise; pollution abounds; and, although pols concur about nothing else, both parties have begun to agree that these are Big Issues the government needs to do something about. And soon.

Before A123 can bring about any green revolution, it has to win the race to produce the game-changing battery.

All the same, A123 still has a ways to go, and more than a few obstacles in its path. Demand for its products is limited by how many hybrids, plug-in or otherwise, are in America's driveways, and that number likely won't spike dramatically from current levels without the aid of a federal carbon tax to bring drivers more pain at the pump; minus an incentive like that, the cost of having two engines—electric plus gas—will continue to make the cars themselves uncompetitive in terms of price. (Further, any significant pollution savings will not come until the exhaust from the smokestacks of power-generating plants is substantially reduced—it doesn't help the environment merely to shift the exhaust from the car back to the plant.) And of course, before A123 can bring about any green revolution, first it has to win the race to produce the game-changing battery. And the field is getting increasingly crowded.

Now that the threat of global warming has become widely apparent, a handful of high-level research outfits across the country and around the world are frantically searching for the Holy Grail of a battery that combines the essentials of long life and serious power with the conveniences of a compact size and a reasonable price. The Japanese—chiefly Panasonic and Sanyo—have been hard at battery R&D for many years now, with major backing from the government. Although these firms tend to work for Japanese automakers, any improvements they make could have serious implications stateside. As for here in the U.S., a Nevada-based company called Altairnano is supplying batteries for the fledgling all-electric-car

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maker Phoenix Motorcars. And EEStor, a Texas operation secretive enough to be dubbed a "stealth company" by industry insiders, is plugging away on a high-power, long-life battery of its own that relies on ceramic powder coated with aluminum oxide. Cars outfitted with its batteries apparently can be recharged in a few minutes—not a few hours, like those that use A123's product—and their charge will last 500 miles, or more than 10 times that of A123's battery. Analysts question whether a single battery can do everything EEStor's is said to—it'd be like a baseball player who hits for power and average and steals bases *and* has a perfect fielding percentage, besides. But rumblings about EEStor's battery

A123 principals profess to be unworried. "There are always uncertainties," says CEO David Vieau. "That's what makes it fun."

obviously have not gone unnoticed in the A123 offices. "There are a lot of companies that claim great things," says A123's Adiletta. "But until you can really see it—and it can be independently tested and validated—you can't make a judgment."

In any case, the principals at A123 all profess to be unworried. "There are always uncertainties," Vieau says. "That's what makes it fun." A123 has that nine-figure financial support, they mention again, not to mention the serious backing from GM, which had other battery makers to choose from. And unlike its competitors, A123 has its fleet of tricked-out Priuses to use as demonstration cars, with its battery packs fitted into the trunk in place of the spare tire. "I tell people to use AAA instead," jokes Chiang, who himself drives one to commute to MIT from his home in Framingham, a roundtrip that flirts with the hybrid's limit for electric-only locomotion. At MIT, he parks in the garage underneath Frank Gehry's futuristic Stata Center. There are spots for electrical cars there, complete with outlets made for plug-ins. His Prius is the only car to make use of them, though of course he hopes to have a hand in changing that. B