



Tesla Motors chairman Elon Musk, who has put more than \$27 million of his own money into the company, with a prototype of the Tesla Roadster. *Photograph by Jonas Karlsson.* For a slideshow of other green cars, follow this [link](#).

Quiet Thunder

Who in his right mind would finance an auto company start-up? Elon Musk, the billionaire founder of PayPal, the guy with a NASA contract for the next space shuttle, also expects to put a sold-out (to the likes of George Clooney, Larry Page, and Sergey Brin) fleet of electric sports cars on the road this summer. Kicking the tires of the \$92,000 Tesla, which goes from 0 to 60 in four seconds, the author learns the Silicon Valley saga of big dreams, technical snags, and *Aha!* moments that could spell the end of the internal-combustion engine.

BY MICHAEL SHNAYERSON MAY 2007

"These are Elise seats," the young engineer from Tesla Motors says apologetically from behind the wheel as our doors click shut. We're snugged into what looks a lot like a Lotus Elise, the slinky, lightweight, low-to-the-ground roadster first issued a decade ago by the high-end English sports-car maker and named after its chairman's granddaughter Elise. The hard-shell seats are brutal, but they'll be replaced. "Ours are wider in the hip area and have more padding," adds Philip Luk, who spends most of his time as a garage monkey under the first, handmade Tesla Roadsters, "so they don't feel so much like race seats."

The red Roadster—the name of the Elise's distant cousin—backs silently out of a company garage onto the streets of San Carlos, California, a once sleepy town south of San Francisco, now part of Silicon Valley. There is no engine noise, because it is a 100 percent electric car—only an eerie whine of gears as the car accelerates. We turn onto an entrance ramp for Route 101 South. And then comes the money moment. Luk floors the accelerator, and the Roadster jumps forward so fast—as instantaneously as its inverter can send electricity to the motor that turns its wheels—that I'm pinned against that hard-shell seat. Zero to 60 in four seconds is Tesla's claim—faster than all

but a few high-performance, gas-powered racecars—with a top speed of 135 miles per hour and a range of 250 miles. It's pretty cool.

This summer, the first production Roadsters are due to reach the asphalt, with a sticker price of \$92,000. No need to ponder a purchase: the full fleet of 2007s is already sold out. Among the buyers who've put down a 100 percent deposit for the inaugural signature series of 100 cars (with buyers' names etched in the doorsill) are actor George Clooney, Google founders Sergey Brin and Larry Page, inventor Dean Kamen, Hyatt-hotels heir Nicholas Pritzker, sportswear designer Julie Chaiken, and Ari Emanuel, founder of the L.A. talent agency Endeavor. A non-refundable deposit. On a car that, when these early believers plunked down their money, hadn't yet passed its crash tests. A car designed not in Detroit or Germany or Japan but here in Silicon Valley, by a team of engineers who have vision and heart and hope for the future but no experience in manufacturing cars. To date, more than 250 additional buyers have put down partial deposits for the first year's daily-expanding fleet.

When these first cars do reach the road, they'll be little more than toys for green-minded California celebrities to drive down Sunset. But, for a young, coolly ambitious Internet mogul named Elon Musk and his partners, the plan is to ride the technology curve down to a more affordable, \$49,000 four-door sedan, then a \$30,000 mass-market model. Musk, 35, wants nothing less than for Tesla Motors to be the Ford Motor Company of the 21st century—liberating the world, at last, from the internal-combustion engine that Henry Ford foisted upon it at just about this time a century ago.

Tesla's success—so far—is testimony to what four years of war in Iraq and \$3-a-gallon gas have done to burnish, once again, the hundred-year-old dream of a practical, mass-market electric car. The world is truly desperate for it. This time—at last—what's under the hood may make that dream come true.

Musk isn't the one who had the *Eureka!* moment. That was a slight, gray-bearded, mild-mannered Silicon Valley entrepreneur named Martin Eberhard. Like anyone else in 2003, the then 43-year-old Eberhard knew that billion-dollar markets had grown almost overnight for laptop computers and cell phones. Rivals were spending huge sums on R&D to pack ever more energy into the lithium-ion batteries that powered those devices. One day Eberhard had a simple thought: Why not put lithium-ion cells into cars?

Eberhard is a bona fide gearhead, with a master's degree in electrical engineering. He started driving at 13, on a farm in Kansas, tinkered with his own cars, and pored through *Road & Track* in search of his next ones. He'd never worked in the car business, though, before Tesla. He'd made his first, modest fortune in computers, and his second, rather larger one as co-founder and C.E.O. of an electronic-book gambit called NuvoMedia. In 2000, Rupert Murdoch's Gemstar-TV Guide International bought NuvoMedia for \$187 million. (Gemstar shut NuvoMedia down three years later amid dwindling business.) Now, with money to indulge his whims, Eberhard commissioned a shy, gifted, sometimes difficult California pioneer of electric vehicles named Alan Cocconi to put a pack of lithium-ion batteries into Cocconi's latest electric-vehicle kit car, the T Zero.

The experiment seemed to work: the T Zero rocketed from 0 to 60 in 3.5 seconds and went on to cruise 300 highway miles on the 6,800 lithium-ion cells in its pack. Eberhard was ecstatic. He told Cocconi he'd find funding to turn the T Zero into a production E.V. Here was their chance, he said, to change the world. Cocconi laughed bitterly. No thanks, he said. He'd been down *that* road before.

Indeed he had. Back in the late 1980s, Cocconi had worked for months in the back of his mustard-yellow ranch house, in the Los Angeles suburb of Glendora, surrounded by circuit boards, hand-soldering the electronic brain of a concept electric vehicle for an unlikely client: General Motors. The lozenge-shaped, two-seat sports car, its body made of raw fiberglass futuristically painted silver, had fascinated General Motors' then chairman, Roger Smith. To the horror of many of his

vice presidents, Smith announced that G.M. would take the concept E.V. to production. And so, thanks in large part to Alan Cocconi's inverter, began America's most recent chapter in the history of electric cars.

Smith was a stiff, ungainly figure who'd made a perfect target for filmmaker Michael Moore in his 1989 film, *Roger & Me*, but he had a Tom Swifbian love of new technology. Ford and Chrysler groaned: they knew exactly what would happen. Within months, California declared that, if G.M. said it could make an E.V., *all* major car-makers would have to do the same—by 1998—for the state so smog-hit that it had won the unusual power to pass its own emissions laws. Grudgingly, the Big Three, along with Toyota, Honda, Nissan, and Mazda, declared they'd do their best to comply with the mandate, as it was called, and cranked up E.V. programs. Privately, all—including G.M.—began lobbying to get the mandate killed.

Cocconi soon grew disgusted as G.M.'s engineers redesigned his concept car with niceties such as air-conditioning and cup holders, and he stalked off in a huff. But in truth, G.M. was the one car-maker committed to a "ground-up" design, its engineers creating parts as lightweight and efficient as possible for maximum range. (Most other car-makers merely adapted heavy gas cars, with predictable results of limited range and poor performance.) Unfortunately, the only market-ready battery technology in the early 1990s was lead-acid, its energy density sorely limited. After all that ingenious engineering, the EV1 had to be saddled with a 1,150-pound lead-acid pack. In the best of weather, on the flattest of roads, it still traveled only 90 miles before running out of juice. Recharge time: about 8 to 10 hours. Late in the game, a new kind of battery chemistry—nickel-metal hydride—came along almost doubling the range, but at a cost that was prohibitively expensive at the time.

In 1996, six years after Smith retired from G.M., the company, rather than sell its first EV1s, leased about 500 of them in Southern California. Six years later, it began demanding them back: the mandate had been quashed, and G.M. wanted to pretend the whole E.V. experiment had never happened. Horrified, the lessees tried to keep them. A young documentary-film maker, Chris Paine, got extraordinary footage of G.M. yanking the last cars from their heartbroken drivers, then crushing the whole fleet, for his critically acclaimed 2006 documentary, *Who Killed the Electric Car?* (The film is now available on DVD.)

Electrics were again dead, as car-makers had declared twice before: once in the 1970s, after OPEC's oil squeeze eased, dooming a few halfhearted E.V. efforts, and a century ago, when E.V.'s lost to gas cars in the first place. In their stead this time emerged hybrids, with Toyota's Prius leading the way. Hybrids use gas for the energy drain of getting the car moving, batteries for cruising speeds: the most efficient applications for both energy sources, or so the new wisdom had it. But hybrids still get filled at the pump, and as a few critics began to observe, a world in which everyone drove a Prius would still be a world dependent—utterly—on foreign oil. Hybrids just delayed the reckoning.

Eberhard began looking for someone who saw the potential of lithium-ion-powered cars. What excited him almost more than the concept was the market opportunity. The big car-makers wanted little to do with electric vehicles. They didn't even want to *look* at new battery technologies, lest California slap another mandate on them. And no one else in the world wanted to start a car company: Preston Tucker in the 1940s and John DeLorean in the early 80s had shown how ruinous that could be. But lithium-ion batteries packed *four times* the energy density of lead-acid—a paradigm-changing improvement. And a lot had changed since Tucker and DeLorean. The more he thought about it, the more Eberhard sensed the time might be exactly right for starting a car company—an E.V.-car company at that. He just needed to find an investor with very deep pockets who saw that, too. To his delight, that someone found him.

One day, Elon Musk had lunch in L.A. with an impassioned young engineer named JB Straubel to gossip about new technologies. At his private company, SpaceX, in the industrial suburb of El Segundo, by the Los Angeles airport, Musk was building manned spaceships, to be test-launched from his own Pacific atoll.

But Straubel could top that: his friends at Alan Cocconi's shop had just put a lithium-ion pack into a T Zero with amazing results. Musk's eyes lit up. At Stanford, before he'd dropped out to join the Internet revolution, he'd intended to study the potential of high-energy-density capacitors. He wanted to see this car.

A month later, Cocconi brought his T Zero over to SpaceX. As soon as Musk climbed into it, he realized it was acutely uncomfortable, very likely a death trap, and hopelessly unmarketable. "I want to buy it," he said.

Cocconi shook his head. "It's not for sale," he said.

"Then put a lithium-ion pack in my car," Musk proposed. "I have a Porsche. You can take the guts out of it and make it an electric. I'd be willing to pay you up to a quarter-million dollars."

Cocconi had no interest in fancy cars like that. He wanted to electrify a Nissan economy car called the Scion. The Scion retailed for about \$20,000. That was the way, he felt, to make electric vehicles mass-market as soon as possible.

Musk sighed when he heard the conversion would cost at least \$45,000. "Who wants to take an ugly \$20,000 car and buy it for \$65,000? That's not a very viable strategy. I wouldn't want to drive it. My wife certainly wouldn't want to drive it." Better, said Musk, to put a lithium-ion battery pack into a high-priced, high-performance car such as a Porsche and make it even faster. *That* someone might buy.

"Maybe you ought to talk to this guy named Eberhard," Cocconi suggested. "He thinks the way you do."

Eberhard and his then 39-year-old partner from NuvoMedia, Marc Tarpenning, had formed a company in July 2003, for the car they hoped to make. Naming it was the easy part: Nikola Tesla, a hero to both men, was the tormented, Serb-born inventor who'd worked for, then fallen out with, Thomas Edison, going on to wage the "war of the currents" with his erstwhile mentor. Edison had pushed direct current, or D.C., for New York's first electrical grid; Tesla had championed alternating current, or A.C., and won the war because A.C. travels better than D.C. Among his 700 patents was one for an A.C. induction motor, now a standard component of any E.V. design. (Batteries generate D.C. electricity that gets chopped by the inverter into A.C. for the motor that turns the wheels.)

Finding backers on Silicon Valley's fabled Sand Lot Road was another matter. Eventually, a couple of small ones said they'd pitch in if Eberhard found a lead investor. Eberhard had begun to despair of finding the angel he needed when Elon Musk called to invite him down for a pitch.

For an hour, Eberhard sat across from Musk's desk at SpaceX, talking about the promise of a high-performance electric sports car. No grassroots activists would be able to afford the first Teslas. But for good or ill, the U.S. supported a \$3 billion market in high-performance cars. A lithium-ion sports car that could break speed records would find a place in that market. Once the technology got established, demand would grow and innovation would make it cheaper—the same inexorable process that had occurred with personal computers, cell phones, flat-screen TVs, and every other high-tech tool of the age.

Musk, as it happened, was a car nut, too. Along with his Porsche, he owned a Hamann BMW M5 sports car, a McLaren F1, and a 1967 XK-E Series 1 Jaguar roadster. He listened intently, asked smart questions, then smiled. "It's kind of crazy," he said. "Who in their right mind would start a car company?" He paused. "But I guess I have more than my fair share of hubris."

After a flurry of e-mails, Musk was in. He would underwrite the whole first round of financing himself. Basically, he promised to see the car through to production.

To date, he's backed up that pledge with nearly \$27 million.

At first blush, Elon Musk looks like a tall, earnest, slightly gawky teenager. His face is unlined, almost cherubic; surely he shaves, but his smooth chin gives no evidence of it. As he folds his long legs under the desk of his modest cubicle at SpaceX—no grander than the cubicles of junior employees who sit nearby—he seems shy, almost deferential, an impression only confirmed by his soft, South African accent. Yet it soon becomes clear that he's never been afraid to think big—very, very big.

"Consider the history of life," Musk offers. "There's probably about a dozen things that, when you zoom out, you still see as being very significant: the advent of single-cell life, the advent of multicellular life, having a skeleton, going from the oceans to land, from cold-blooded to warm-blooded." As he recounts it, by the time he got from South Africa to Wharton business school to study physics and finance, he'd decided there were at least two such notable projects in his time that he wanted to influence. One was how to prevent humans from destroying the planet with carbon-based fuels. The other was manned space exploration to Mars.

Musk was two days into his Ph.D. at Stanford when he realized that a third notable project—development of the Internet—was about to pass him by. He dropped out in 1995. "It was not with the intention of making huge sums of money, because nobody had made any money on the Internet," he says. "My intention was to be part of building what I thought would be a great thing."

Musk's first success was a start-up that provided platforms for newspaper companies to migrate online. *The New York Times*, Hearst, and Knight Ridder were among his customers; in 1999 he sold the business to Compaq for \$307 million. His next idea was a one-stop, online financial-services company, offering everything from banking to insurance. It included a feature that seemed innocuous at the time: a way to send money online from one person to another. To his surprise, venture capitalists got a lot more excited about PayPal, as it would come to be called, than about the rest of his plan. So did everyone else. Musk took PayPal public in early 2002, then sold it to eBay for \$1.5 billion.

By then, Musk had had enough of the Internet. Of the two Big Things he wanted to do, space travel seemed the more compelling challenge. He started SpaceX with the express intent of building rockets to take mankind—and other species—to Mars. In this, he notes, the physicist Stephen Hawking had the same idea: that, in order to survive, man will have to extend life beyond Earth. Once you accept that, Musk says, "the only realistic place for a growing human civilization is Mars."

Mars is still a distant goal. But already, Musk says, SpaceX has rockets powerful enough to launch from any point in the world and land at any other point. Rockets, he acknowledges, that could carry weapons rather than astronauts. "Of course," he says blithely, "our technology is far beyond what, say, a North Korea or an Iraq has. Far beyond."

All this might be dismissed as hype—so far, SpaceX has conducted exactly one "partially successful" demonstration launch, and recently aborted a second—were it not for the fact that NASA has committed \$278 million to the first part of a contract for SpaceX to design, build, and manage the successor to the Space Shuttle. Depending on how many flights the U.S. signs up for, SpaceX stands to earn between \$300 and \$400 million a year from 2011 through 2028 with the program.

For Musk, funding Tesla was the way, at last, to grapple with the other Big Thing. Daunting as it might seem, building an electric vehicle was not, after all, rocket science. And Musk needed little convincing that the time was right. Lithium-ion batteries weren't merely better than lead-acid and nickel-metal-hydride. They were almost certain to keep getting better over the next decade. The

other essential parts of an E.V. drivetrain—an A.C. motor and the power electronics that control it—were rapidly improving, too.

With his distinctive brand of enthusiasm—quiet but absolutely authoritative—Musk talked Google founders Larry Page and Sergey Brin into coming along for the ride as passive investors, together with Silicon Valley stars such as VantagePoint Venture Partners, Valor Equity Partners' Michael Dubilier, and Draper Fisher Jurvetson. Now Tesla had the money it needed. Its founders had merely to design a new kind of car, manufacture most of its parts, make them work together, get the car to market—and at the same time build America's first new successful car company in nearly a century.

Eberhard began by ordering up sketches from four automotive designers. At a Christmas party in December 2004, he taped them to a wall in his home and asked Tesla's first employees to choose their favorite—and least favorite—aspects of each design, using green and red stickers. The sketch by Barney Hatt, of Lotus Design, earned the most green dots by far. His design was a racy departure from the Elise, close enough that Tesla could use some of its chassis, different enough that it could legitimately be called a new car. The Lotus Elise also happened to be, at 1,984 pounds, the lightest production car on the road—a good start for any E.V. And as a small, high-end car-maker, Lotus was willing and able to do final assembly on the first micro-fleet of Roadsters, in England.

Clearly, though, a lot of the Roadster would have to be made from scratch, starting with its drivetrain. In Detroit, the engineers of a new car program begin, at least, with CAD/CAM computer systems to work up their designs on; a whole corporation of resources, from clay modelers to wind-tunnel operators, to draw on; and a far-flung network of known parts suppliers. Tesla had none of those advantages. It didn't even have automotive engineers. "When we started," recalls JB Straubel, the young engineer who'd put Musk onto the T Zero and signed on as one of Tesla's first employees, "we had nothing. We didn't have a screwdriver. We had an office."

In the wide, echoing workspaces of their San Carlos Skunk Works, Straubel and a growing number of engineers struggled to design the heart of the car—batteries, inverter, computer, and motors—then fit it *into* the car. The battery pack was the greatest of those challenges. The news of Dell laptop battery packs bursting into flames would not make headlines until the summer of 2006, but the risk of thermal runaway, especially when 6,000 lithium-ion cells were bound together and made to handle huge jolts of current, was all too clear. In cars, as in laptops, the cause could be a manufacturing defect or an overcharge. With cars, unlike laptops, a third cause could be a car crash.

"There have been five laptop fires so far, and it's front-page news," gripes Ian Wright, Tesla's first head of vehicle development. "There are 750 gas-car fires each day, but that's not news." With lithium-ion batteries, Wright says, "you have to get to 150 centigrade before you get thermal runaway. Active operation is 25 degrees centigrade, and they have a cooling system. You'd need multiple system failures before you had a problem." The likeliest way to ignite the batteries, he says, would be to get your Roadster run over by an S.U.V., with gasoline from the S.U.V. pouring over the battery pack, and have the gas catch fire. "Eventually the pack will burn," Wright says, "but that will be the least of your problems by then." In the final design, says Malcolm Smith, Tesla's current head of vehicle development, "we've put systems in place that, if a cell for some reason actually goes into thermal runaway, it won't propagate."

With batteries, cost was the other big challenge. One insider pegs the price of a lithium-ion pack for the Roadster at \$20,000. "Our battery cost is the highest part of the car," Straubel allows, "but it's in no way higher than the value we're selling the car for. We are making money on the cars." Those packs will get much cheaper if Tesla sells a lot more cars and so can buy its batteries in volume the way Dell or Samsung does—a prospect that G.M. simply didn't have with its advanced nickel-metal-hydrate batteries for the EV1, because no one was making enough of them yet for the costs to come down.

Along with the drivetrain, Tesla's engineers had to grapple with another dilemma unique to E.V.'s: what to do about the charger. For its EV1, G.M. had designed a charger that stood outside the car like an old gas pump. It had a cord as big as a gas hose, with a strange, paddle-like disk that slid into a slot on the side of the car. A driver had no choice but to charge his car that way, so he was tethered, as Musk says scornfully, to those chargers.

From the start, Musk insisted that the Roadster have a charger built right into it, and so it does: the electronics have grown small and light enough to make that possible. Now all a driver needs is a cord to plug into his car. Refuel times are still considerable: about 3.5 hours for a complete recharge using a special, thick cord attached to the household grid, or at the very least 12 hours using an ordinary 110-volt cord. But Marc Tarpenning, Tesla's co-founder, has an answer for that. "We expect to tell upscale hotel chains and restaurants to put charge posts in," he says, "because the posts are inexpensive and Tesla owners will be a very desirable demographic group." Some drivers will still balk at having to charge a car for hours instead of gassing up in minutes. But for how long? "As the battery technology gets better," Tarpenning says, "the mileage will continue to increase. At what point is it really not an issue? Five hundred miles? Would people complain about how it takes hours to recharge with a 500-mile range?"

For a car, Musk adds, that means the benefits of no trips to the pump for \$3-a-gallon gas, no oil, no oil changes, no fuel filters, no new catalytic converters, and no emissions inspections, not to mention the satisfaction of generating no emissions at all.

As Tesla's engineers designed their drivetrain and charger, they saw that more and more of the Roadster's surrounding parts would need to be reconfigured. Lotus hadn't signed on to make new parts, so new suppliers would have to be found. A generation ago, the Big Three would have made that search almost impossible: they owned all the suppliers that made all the parts, and they weren't inclined to share. "DeLorean literally was out trying to make windshield wipers," marvels Tarpenning of the G.M. rebel who, against all odds, managed to manufacture almost 9,000 of his gull-winged sports cars before slipping into bankruptcy.

But times had changed. To save money, the Big Three had come to outsource everything but their internal-combustion engines—the very "core technology" that Tesla's engineers *didn't* want—to outside suppliers, who were happy to sell them to Tesla or anyone else. So the engineers had the luxury of designing their own parts. Musk, it turned out, had some strong opinions.

One fierce debate was whether the Roadster should have headlight covers or not. "My opinion," says Musk, "was that if we had uncovered headlights it would look like a kit car—a little cheesy." Eberhard pointed out that the change would cost half a million dollars. Musk said he'd pay.

Eberhard had no problems with the doorsill, but Musk did. It was difficult to step up into the car, so high and thick was the sill. At Musk's insistence, the engineers redesigned it, narrowing it and lowering it by two inches. It was Musk, too, who refused to use those hard-shell Elise seats. A carbon-fiber body replaced the fiberglass one. "On some of these changes I had to be quite forceful," Musk admits, "because Martin [Eberhard] didn't want to spend the money."

As Tesla's workforce grew—from a handful of engineers to a company of more than 80 by late 2005, the year the first prototype cars, or "mules," were made—Eberhard was struck by its diversity. Its *political* diversity. In Washington, an administration set on exploiting partisan issues had deepened the lines between red and blue states. But eager arrivals from both sides of the political divide had made their way to Tesla's sandstone bunker in San Carlos.

One of the new arrivals was Ron Lloyd, 47, a big and burly former plant manager for Sun Microsystems, who called himself a fiscal Republican. Lloyd had retired at 42 to go fishing, but a growing concern about global warming had pushed him to Stanford for a master's degree in environmental engineering. When he called, Eberhard and Tarpenning weren't sure how they

could use him. But they knew they wanted their four-door follow-on sedan, code-named White Star, to be assembled somewhere less expensive than England. Maybe Lloyd could help.

"I said, 'I don't care, take me, don't pay me, I'm coming,'" Lloyd recalls. "At the end of the day, for me, this is about making a change in the energy policies in the United States. I can't imagine there are many times in anyone's career where they get to have that kind of a potential impact on the world. And to see one of those happen and not grab it, I think, would be almost criminal."

Diarmuid O'Connell, Tesla's director of strategic affairs, wasn't merely a Republican voter. Until last year he worked for the Bush administration as a mid-ranking chief of staff in the U.S. State Department. "We were basically tasked with all sorts of military policy and operational support to the uniformed military in Iraq and Afghanistan," O'Connell says in brisk government-speak. Every morning, a list of the latest American casualties crossed his desk. "I developed a very poignant realization that ... energy security is all about oil, and if it's all about oil, you better be doing something about transportation."

In the spring of 2006, O'Connell saw an early article about Tesla in *Business Week*. The next day he was in San Carlos, talking to Eberhard about how he could use his government experience to help Tesla lobby for state and federal subsidies and tax breaks.

By the time O'Connell arrived, the first mules had been built by hand and test-driven to see how all those much-debated parts worked together. The mules weighed all of 2,600 pounds each, 400 pounds less than a small economy gas car, or about half the weight of an S.U.V.: good for range, even better for speed. Late at night, the mules began rolling onto the freeway ramp, stopping, then rocketing forward. An engineer rode shotgun, recording data on a laptop plugged into the car's controls. One night, JB Straubel took a modified mule out and for the first time hit 0 to 60 in four seconds. For a car meant to be high-performance, that was the moment, Straubel felt, that the Roadster came to life.

There were problems—for one, the mules' engine mounts cracked when Straubel floored the accelerator—but by the spring of 2006 fixes had been made, and Eberhard felt confident enough to have the initial 10 prototypes made in England. The first of them reached California just days before the Roadster's scheduled launch date—July 19, 2006. So far, the only cars actually sold were to Tesla's investors.

The night of the launch, in Santa Monica, a lot of celebrities mingled with automotive journalists and E.V. geeks. Eberhard had often run up against what he called "E.V. burnout"—the tendency of E.V. pioneers to lose all hope that E.V.'s would ever reach the market. There wasn't any burnout in evidence that night. Potential buyers and backers began taking test-drives, proving to themselves that the Roadster does, in fact, accelerate from 0 to 60 in four seconds. Within a month, the first 100 of the still-unmade 2007 production Roadsters were claimed.

For all their success, not everyone at Tesla felt the car was on the right course. Ian Wright, 51, Tesla's first head of vehicle development, is a New Zealand-born computer engineer and amateur racer who signed on almost as soon as the company was founded. He'd even helped make the original pitch to Elon Musk, joining Eberhard on that fateful trip to SpaceX. Wright loved the Roadster. He just didn't feel that Musk's grand scheme of producing cheaper follow-ons made sense. "I didn't want to go the route of family cars," Wright explains. "I want even higher performance."

Wright's point is that most Americans spend no more than \$2,000 on gas a year. How much of a premium would they pay for an E.V. that saved them \$1,000 a year in fuel costs? Would they buy a \$30,000 car, let alone a \$50,000 one, that did that? Perhaps some would, he concedes. But wouldn't they be the ones who would have bought a Prius hybrid instead? And if so, what was the difference between a Prius that got 50 miles per gallon and an E.V. that got the equivalent of 100

miles per gallon? A mere doubling of the efficiency of a modest number of cars. "So replacing the Prius with an E.V.," Wright argued, "doesn't solve the problem."

Better, Wright said, to make even higher-performance E.V.'s to replace ever higher-performance gas cars. If Wright could replace 10,000 high-performance gas cars that got 10 miles per gallon with high-performance E.V.'s that got 100 miles per gallon, *that* would be meaningful. "It's certainly true that gas will get more expensive and batteries will get cheaper, and eventually you'll get a mass market," Wright argued. "But in the meantime the answer is high performance."

So Wright left to design his own two-seat racecar, the Wrightspeed X1. He says it accelerates from 0 to 60 in *three* seconds. But it's still a concept car in search of an angel. "We were very lucky finding Elon at Tesla," Wright says. "You can't always get that kind of luck, and in fact I haven't."

Last fall, Marc Tarpenning went to the Palo Alto car rally, always a nexus for alternative-energy cars. He saw Ian Wright touting his X1, and he saw a two-seater called the Tango, but aside from the Roadster, those were the only ones even close to market. Various zealots peppered him with business plans: *I did this great thing in my garage, and I want to make it into a real car, and I think it's only going to cost \$2 million to get it into production.* Tarpenning shakes his head at the memory. "They have no idea what it takes," he says with hard-won wisdom. "The safety certifications alone are millions and millions of dollars.... Worldwide we have 140 people working on getting the car into production. It takes tens and tens of millions of dollars."

As of early 2007, the work goes on. Not long ago, four hand-built Roadsters were taken to Germany and systematically destroyed. The crash tests were done by Siemens, the company that made the air bags for the Lotus Elise. Siemens had such liability concerns about Tesla's using its air bags, Elon Musk admits, that the only way to allay them was to have Siemens do the crash tests itself. So far, the results are encouraging. "We've already passed the tests we were most afraid of," Musk says. Now his engineers will take what they learned from those crash tests, plus the torture-track tests, tweak the Roadster a bit more, call that design final, and build a few more of those cars to crash.

Then—if all else goes well—hundreds of Roadsters will be built at Lotus's factory in England and sold to eager buyers. No one at Tesla wants to set a firm arrival date: the tests could still create delays, or the manufacturer of a single part might have a problem. But Musk has no doubt that Roadsters will be on the streets by late summer. Tesla dealerships and service centers, he vows, will follow soon after—though how they'll make a business of selling and fixing a few hundred cars is anybody's guess. Musk expects the four-door White Star to hit the market in 2009, with the \$30,000 mass-market car the year after. His goal is 10,000 cars a year.

In his office at SpaceX, Musk radiates an almost eerily cool confidence. The recent news that G.M. will introduce a plug-in hybrid Chevrolet called the Volt, and that Toyota may produce its new concept plug-in hybrid, the FT-HS (Future Toyota Hybrid Sport), bothers him not at all. "Too little too late," he scoffs. He feels absolutely sure that Tesla's coming at exactly the right market moment.

"I expect it to be a raging success," Musk says. "Honestly? I expect Tesla to be worth multiple billions of dollars."

Michael Shnayerson is a *Vanity Fair* contributing editor.