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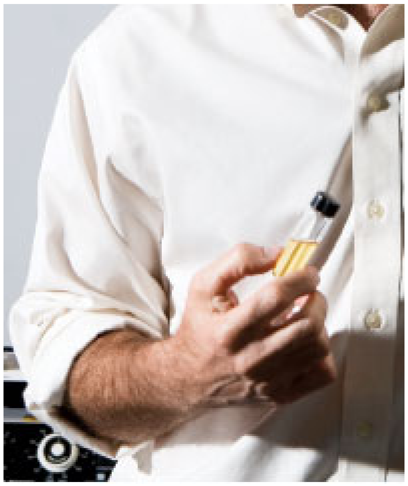


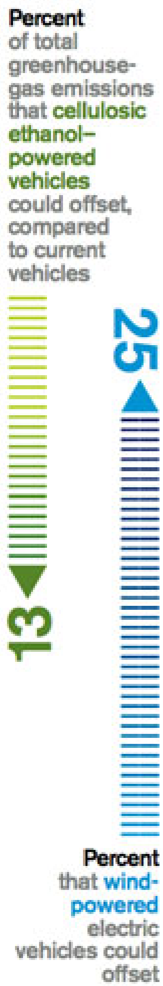
Are we backing the right fix for global warming?

By Jaimal Yogis

Calvin Laboratory sits on the southeast side of the UC Berkeley campus, next to the Haas School of Business and below the Bears' stadium. The building itself looks like an oversize concrete soda can with a Saturn-like terrace wrapping around the base. On a sunny morning over the summer, I meet with superstar biologist Jay Keasling in his office at the lab. A fit, middle-aged man, Keasling has just finished a meeting with some students, and, as we shake hands, he actually seems to quiver with excitement about whatever research project they were discussing.

Such enthusiasm is business as usual for Keasling, and likely what has propelled him to a level of achievement beyond most scientists' dreams. Last year, he received *Discover* magazine's Scientist of the Year award for a unique genetic engineering method that allowed him and his private company, Amyris Biotechnologies of Emeryville, to cheaply convert wormwood into artemisinin, an antimalarial drug. With the help of the Bill and Melinda Gates Foundation and the Institute for OneWorld Health, artemisinin will soon be distributed to the Third World nearly at cost. If all goes well, by 2010 the drug will help save thousands of lives. Amyris will not profit from the sale, "but I was never in science for the money," Keasling says.

If last year for Keasling was all about saving the Third World, this year has been about saving the entire world. He is now employing his skills to develop what he calls next-generation biofuels, petroleum-like liquids derived from the cellulose inside plants. He believes such fuels, unlike corn ethanol, the biofuel that's becoming a controversial staple of the U.S. energy industry, will be key to bailing the earth out of its global warming mess. Although Keasling's biofuels are still in the experimental phase, an astonishing amount of money is being bet on them—and him. Swept up in the green-tech boom that's transforming Silicon Valley and academia, Keasling's company has raised tens of millions in venture funding. He's set to head up a new $125 million biofuel lab at Lawrence Berkeley



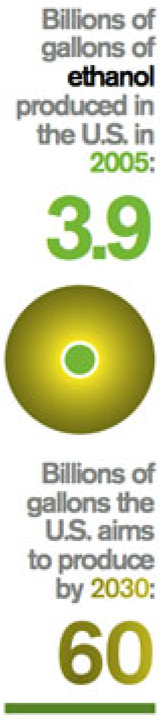
National Laboratory, funded by the Department of Energy (DOE), and he is one of the key figures behind the $500 million grant, announced in February, from the world's third-largest oil company, BP, to UC Berkeley. The biggest such award ever made to a university, the corporate grant will fund a new energy lab with equal parts hope and expectation riding on it. Berkeley Lab chief Steven Chu, a Nobel Prize–winning physicist, has compared it to the Manhattan Project, the World War II–era effort to create the atom bomb.

Keasling is a synthetic biologist, a scientist who combines molecular biology, genetic engineering, and chemistry. "My specialty," Keasling tells me, "is manipulating the chemistry inside a cell. With the advancements in DNA sequencing, now we can make just about any chemical we want. I basically get cells to do chemistry, and this can be used to make a drug or a new fuel." When he gets to the word fuel, Keasling leaps up to the whiteboard to draw a diagram. "So," he adds with a professorial grin, "this is what we're trying to do. It's essentially the same process as making moonshine."

Step one, Keasling explains as he draws small arrows and green leaves: take a plant and extract cellulose, the structural polysaccharide that makes up green plants' cell walls. Step two: toss in some enzymes called cellulases—proteins that catalyze chemical reactions—and convert the cellulose molecules into sugars. Step three: ferment those sugars into alcohol. Finally, distill the alcohol into fuel called cellulosic ethanol.

It sounds simple enough, but there are at least two catches, Keasling says. Evolution has made plants' cell walls almost indestructible. Technically, scientists have figured out how to break down cellulose (using relatively unsophisticated enzymes that work very slowly), but they've yet to bioengineer a super-enzyme or microbe that can do the job efficiently enough to create fuel that competes with gasoline in price.

The second problem is that many scientists don't see great benefits for any existing ethanol, corn or cellulosic. These ethanols don't produce as many greenhouse gases as oil does, because they come from carbon-sucking plants, and, when they burn, they release only carbon that's already been in the atmosphere. (Oil releases ancient carbon that's been stored deep in the earth.) But it takes large amounts of carbon-producing energy to farm and produce these ethanols, they get fewer miles per gallon, and they're too corrosive for current pipelines and cars (unless blended with 15



percent gasoline). To switch from an oil to an ethanol economy would require not only retooling our cars, but also creating fleets of gas-guzzling trucks to transport the fuel. Not the best way to slow climate change, Keasling notes.

His big idea, then? To create a whole new type of cellulosic biofuel that's cheap to produce and has a chemical composition very similar to that of petroleum, which means it could flow down our 200,000 miles of pipelines to our 170,000 fueling stations and straight into our cars. Standing at his board, pen in hand, Keasling almost makes me see it: the fantasy app that will change the future without making us change (too much). Coupled with 100-mile-per-gallon hybrids that could reduce the need for any fuel, Keasling's almost-greenhouse-gas-free version sounds downright Nobel Prize–worthy. Indeed, it's exactly the fuel BP would love to see come out of its $500 million deal with Berkeley. And if Chu is right that the BP lab has the potential to be as history-making as the Manhattan Project, let's hope it works out as well as Keasling and others claim it will.

When the extraordinary news came out that UC Berkeley would receive half a billion dollars for bioenergy research from BP—an oil company desperate to ensure its future in a greening world—the groans could be heard across the land. Why was the world's leading public university trying to fix global warming by getting in bed with an oil company that helped create the disaster in the first place?

This initial knee-jerk reaction was followed by heaps of complaints about BP's hypocritical environmental record. (In October 2007, the oil giant agreed to pay $20 million in criminal fines and restitution for last year's oil spill in Alaska.) But subsequent attacks homed in on the university. After all, BP is beholden primarily to its investors, while UC Berkeley is committed to do research for the "public good."

Convinced that the public would not be well served in this case, a group of graduate students distributed posters of UC Chancellor Robert Birgeneau with green-and-yellow BP symbols in his eyes, delivering a now-infamous quote: “If BP hadn’t come along, we would have pursued another strategy, whether it was with another oil company...er, energy company, or what have you.” Underneath, the tagline read: “Cal Sold to the Highest Bidder.” The state’s major newspapers jabbed at both BP and UC for keeping the contract specifics secret. Given BP’s checkered environmental record, the history of problems with industry-funded science, and the fact that the two main professors behind the deal—Keasling and Christopher Somerville, the Stanford biologist slated to run the UC/BP lab—are invested financially in the new fuels, opponents also questioned whether the BP lab would become a publicly subsidized biofuel factory instead of an impartial, eco-friendly research center.

As withering as the critiques have been, the scientists driving the deal have been just as tenacious in defending it. While the earth faces its biggest threat yet, they argue—billions of pounds of greenhouse gases spewed into the atmosphere each year, with oil production expected to peak sometime in the next half-century—it makes perfect sense that Cal scientists would lead the way in finding solutions. When I interviewed Chancellor Birgeneau in May, the physicist recalled, with his standard confident grin, that the university’s leadership position was essentially established by Ernest Lawrence and Robert Oppenheimer, whose role in building the atomic bomb helped usher in the university’s long (and lucrative) funding relationship with the federal government. Today’s mission is equally important, he told me. “We need to address climate change. And I think with the incredible talent of this university, along with the talent on the hill, we can do that in a way that not many other institutions can.”

The “hill,” of course, is Lawrence Berkeley National Laboratory, where the voluble Chu, whose thinking spurred Birgeneau on, didn’t mince words when describing why the BP deal makes sense: “If you want to change the world, and if you want to have something that goes beyond academia, you have to work with industry.” Birgeneau added that BP and UC Berkeley’s research goals are “entirely symmetric.”

It’s an audacious vision, especially for a university that constantly struggles with the financial monkey on its back and could use the millions it might reap from licensing a bunch of landmark patents.

The BP grant, which will be shared by Lawrence Berkeley National Laboratory and the University of Illinois at Urbana-Champaign, will instantly create the nation's largest alternative-energy lab. The new Energy Biosciences Institute (EBI) will host up to 150 academic scientists and BP employees to work largely on biofuels but also on other energy problems, such as using microbes to extract oil from the earth. Combined with Keasling's baby—the new DOE-funded Joint BioEnergy Institute, which will spend another $125 million on cellulosic biofuel research—Cal suddenly looks like the most important place in the world for biofuel research.

A story in a UC Berkeley publication boldly describes the EBI's work as nothing short of "this generation's moon shot," and Birgeneau and Chu have both speculated that it could transform the Bay Area into an international energy hub filled with hundreds of clean-energy startups.

Still, with all the heavy issues flying around campus like protons in an ever faster particle accelerator, it's hard to know whether to feel optimistic or sad. The parties in this green-versus-green debate over the future of the university and the planet all have noble intentions. Yet everyone is also nervous, and increasingly not just because of BP, but also because of the technology UC has chosen to launch the rocket ship.

Indeed, Keasling and Somerville's dream of cellulosic biofuels has not been universally embraced. To opponents, cellulosic fuel looks suspiciously like a way for industry to sell genetically modified organisms to a skeptical public, as well as like a Trojan horse for the farm and oil lobbies that may ultimately starve the world's poor by replacing food crops with fuel crops. There's also some skepticism about whether the technology will ever work well or cheaply enough to generate a mass-market fuel. The big worry, though, is that the emphasis on biofuels might eclipse cheaper, better alternative energies that are much closer to fruition.

Despite these widespread concerns, there may already be no turning back. UC has to follow the money, whether private or public—and thanks to a new, convenient alliance between the conservative federal government, green-energy investors in Silicon Valley, and the farm and oil lobbies, biofuels have become the darling of biotechnology.

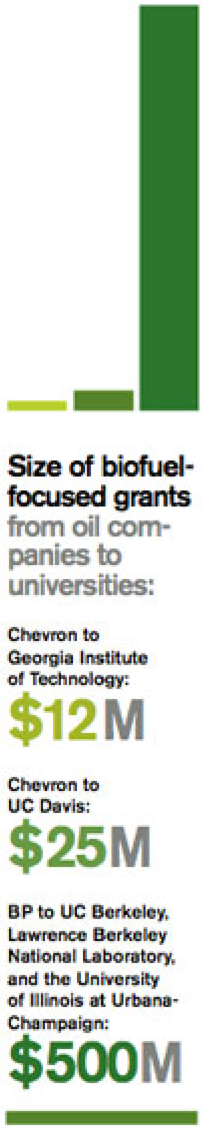
Starting in 2000, several federal bills—plus President Bush's mention of switchgrass (a key natural element in biofuel production) in his 2006 State of the Union address—have sent millions of public dollars to the development of biofuels, sparking waves of private investment. It was also in 2006 that Vinod Khosla, the prophetic VC who cofounded Sun Microsystems, made the rounds to congress, entrepreneurs, Stanford students, and Wired readers, touting cellulosic biofuels over every other alternative. Venture capital firms like Kleiner Perkins Caufield & Byers and Flagship Ventures followed Khosla's lead, supporting biofuel startups in the Bay Area and beyond.

In retrospect, the situation seemed wired for UC to bet on biofuels. When BP announced its $500 million plan, Chu—whose own research has led him to believe that biofuels deserve the most research funding—already had Keasling and Stanford's Somerville in mind. The two biology stars had each founded Khosla-funded companies working on the very fuels that BP wanted to see result from its investment. Both men had also just contributed to a mammoth DOE study praising the tech-nology's potential. Somerville, widely revered as the best in the plant biology business, seemed like the obvious choice to direct the lab.

So BP's chief scientist, Steve Koonin, wrote to Birgeneau and asked him to compete with 13 other univer-sities for the grant. Keasling and Somerville worked madly on the proposal. UC tacked on letters of support from Senator Dianne Feinstein and a list of Silicon Valley heavies, and soon Governor Schwarzenegger threw in $40 million to build the lab on Berkeley's campus. John G. Melo, one of BP's top executives, was named CEO of Keasling's Amyris. By the time the deal was announced in February, the UC Berkeley described in the proposal—one that would do everything in its power to inspire a new Northern California economy of startups devoted largely to cellulosic biofuels—was already a reality.

If you're confused about how a privately funded biofuel lab at a public university will collaborate with other private biofuel businesses founded by publicly funded professors, you're not alone. Ever since a little-known piece of legislation called the Bayh-Dole Act was passed in 1980, universities have had more ownership rights to potentially lucrative patents that come from their researchers' discoveries, access to which is a draw for innovation-hungry corporate sponsors. (Since 1980, private funding for the UC system has increased tenfold.) It's a controversial and highly complex subject, but the intersection of the BP deal with Bayh-

Dole seems to break down like this: BP gives money to the university. Professors submit project proposals, and an executive committee (composed of representatives from eight or nine universities and two from BP) decides which ones to fund. If a researcher succeeds in making a marketable scientific breakthrough—say, with a new and improved enzyme to break down cellulose—BP gets first dibs on the exclusive rights to that enzyme. But in the wake of Bayh-Dole, UC Berkeley has established a policy that the researcher will also reap 35 percent of any profits that flow from the patent. And if BP agrees to share its exclusive rights, the university can then either license the patent to other corporations (like Keasling's Amyris) or spin off into a new startup.



Located in one of many cookie-cutter warehouses off Industrial Road in San Carlos, LS9 is a private biofuel company hoping that research from the UC/BP lab will help it bring to market a cellulosic biofuel similar to Keasling's. Khosla and Flagship Ventures essentially started the company by getting Keasling and Somerville together with George Church, a biotech professor from Harvard, though Keasling has since begged out, amicably, because his Amyris has become a biofuel competitor.

In LS9's small front offices, all fluorescent lights and cheap carpeting, I feel like I could be waiting for a dentist's appointment. But in the lab, it's a different story: young scientists in white coats peer through microscopes, analyzing miniscule drops of liquid. Cartoon-like glass chemistry sets perch on the counters, and something called an incubator-shaker vibrates and churns like an ice-cream maker. Apparently, the tiny microbes that break down cellulose are being grown inside.

Because of the noise, it's hard to talk, so Gregory Pal, the young senior director of LS9, keeps things simple: "Imagine that this is like The Matrix," he yells over the din, "the scene where Keanu is trying to learn all those martial arts really fast, downloading the traits of awesome fighters into his brain. Here, we're trying to assemble the traits we want in our fuels from various strands of DNA. And we literally have a phone book–size book of methods for doing that." In a perfectly timed segue, Stephen del Cardayre, the company's vice president, taps me on the shoulder. "Here's the fuel," he says. "It doesn't look like much, but we have high hopes." He lifts a tiny vial, about half the size of his pinky, full of a clear liquid with a blue-green sparkle.

According to at least one recent study, this twinkling fluid could reduce greenhouse-gas emissions from cars by up to 85 percent. "We've basically figured out how to make it," says del Cardayre. "Now it's just about bringing the price down, because nobody is going to pay $20 per gallon." This price reduction will come from streamlining the enzymes to break down cellulose and/or genetically enhancing fuel crops—most likely perennials, such as miscanthus and switchgrass—to maximize per-acre production. Those are two big hurdles to clear, but del Cardayre and Pal are convinced they can do it, with some collaboration from the BP and DOE labs. "We'll do whatever it takes to get these fuels into gas tanks," del Cardayre says. And while LS9 has no plans to sell out, they're open to all options. "If getting these fuels out there faster means selling the company to BP or another mammoth energy company, we'll consider that," adds Pal. "If staying independent is more efficient, we'll do that."

Del Cardayre and Pal admit that scaling their fuels to run America's cars will require crucial ice cap–melting time. They're also still not sure how clean the fuel's tailpipe emissions will be. But the DOE has set a goal of replacing 30 percent of gasoline consumption with cellulosic biofuels by 2030—so whether or not such fuels have a positive overall effect on the environment, there will almost certainly be a market for LS9's products. In addition, LS9 isn't trying to make cellulosic petroleum just for cars. "We're working on nearly every type of fuel that seems useful," says del Cardayre, including fuels that run better in warm or cold climates and ones for diesel trucks and jets. "And let's say electric cars become the next big thing," he adds. "You're not going to have an electric 747 or 18-wheeler. Jet fuel by itself is about a 20 billion gallon–per-year market, so it's just a matter of how big we want to get."

Despite the potential advantages of the fuels in progress at LS9 and slated for development at the new UC/BP lab, not everyone thinks a bunch of private companies and entrepreneurial professors, almost none of whom specialize in the environmental impacts of new technology, should be leading Berkeley's fight against global warming. "What the chancellor decided was to hear the opinions of chemists, molecular biologists, and engineers over the opinions of ecologists," says Miguel Altieri, a professor at UC Berkeley's College of Natural Resources.

Altieri has a point. There are many unpredictable factors about biofuels that researchers focused on microscopic enzymes and plant cells often don't have time to consider. (In our interview, Keasling himself said he hadn't looked at the exact environmental impact of cellulosics.) One missing element in the equation: where will biofuel companies grow all

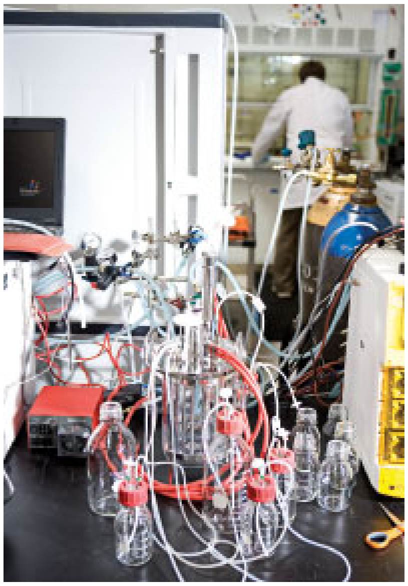
these crops? “I think biofuels are a piece of the puzzle,” Joseph Romm, a former high-ranking DOE officer, told me recently, “but even in the U.S., which has much more excess arable land than almost every other country, it may still be difficult to find enough space.”

Even Somerville, the EBI director, recently told Science Daily, “a lot of deforestation [is] certainly going to take place in tropical regions, because those countries are going to develop biofuel businesses.” In the worst-case scenario, deforestation could speed up climate change faster than adopting biofuels can help slow it. According to a recent UN report, clearing forests to make room for fuel crops could “result in large releases of carbon from the soil and forest biomass that negate any benefits of biofuels for decades.”

Of course, using chunks of land to grow fuel crops instead of food would avoid that problem, but it could also drive up food prices, just as increasing demand for corn ethanol has nearly doubled the price of corn, sparking protests in Mexico. Cellulosic biofuel crops like miscanthus and switchgrass are many times more energy-efficient than corn, but it would still take an area up to the size of 3.5 Californias planted entirely with these crops to run the U.S. fleet of cars and trucks. This may be possible, but critics fear the food supply will take too great a hit. Tad Patzek, an environmental engineer at UC Berkeley and one of the BP deal’s most public critics, says that the government’s goals of replacing gasoline with biofuels would leave little room for food production. “In effect, the brave new U.S. economy would be dedicated to feeding cars, not people,” he wrote in an analysis of the DOE’s plan. And given the rate of population growth, we’re likely to need a lot more land for food in the future—not less. The most extensive scientific report yet published on global warming estimates that in Asia alone, future climate change is expected to put an additional 50 million people at risk of hunger by 2020.

Another potential negative is the increased use of genetically modified (GM) plants, a probable component of any biofuel economy. (GM corn is already used to grow corn ethanol.) The debate over GM plants is one of the most heated in the world. It has motivated mass international protests and even some suicides among farmers in India, who mistakenly entered into contracts with transgenic seed companies and then couldn’t pay their steep fees for GM seeds. Critics say we don’t know enough about the long-term effects of modification—on people and the earth—to risk planting genetically altered crops.

“A hurricane remains more predictable, and a wildfire more controllable,



than GM organisms," said UC biologist Ignacio Chapela—famous on campus for his opposition to UC Berkeley's last controversial corporate deal, with Novartis in 1998—at a recent UC meeting on the BP deal. (He was denied tenure for several years and became a cause célèbre.) Chapela, along with other scientists, has produced a study replicated by the Mexican government: it demonstrates how transgenic corn cross-pollinated with natural corn in Mexico could impact the diversity of the country's crop, thus threatening a staple of Mexico's economy. To avoid this problem, Mexico has placed a ban on GM corn.

Advocates of the UC/BP lab are aware of all these controversies—Daniel Kammen, a renewable-energy and policy professor at Berkeley who has been actively involved in the ethics side of the lab, says the critics' points are well taken—and they are trying to build safeguards into the deal. For example, one of the six key sectors of the UC/BP lab will focus on the "social issues and economics of biofuels," considering how they might affect indigenous communities living where the fuels might be grown. "There are so many ways to develop biofuel systems that are not good for the poor, and far fewer success routes," Kammen says. "Our job is to be vigilant throughout." Although biofuels are the lab's main focus today, he adds, it's entirely possible that other alternatives—such as turning plants into natural gas instead of ethanol—may eventually take precedence.

Still, even if research reveals prohibitive social and environmental impacts of biofuel development, everyone knows it won't be easy to derail it. Many also believe better alternatives will get short shrift in the deal. "Every dollar spent on an ineffective solution to global warming is one less dollar spent on a better solution," says Mark Jacobson, an environmental engineer at Stanford who champions wind- and solar-powered electric cars. "What BP is doing is just crazy. We have technology now that could address this problem."

When I visit Jacobson in his Stanford office, the first thing I notice is a bulletin board outside his door, displaying stories from *USA Today*, the Associated Press, the BBC, and the *Washington Post*. They're all about a recent study he published in the journal *Environmental Science & Technology* that didn't make biofuel advocates very happy. Using an elaborate atmospheric computer model, Jacobson found that replacing gasoline with E-85, a blend of 85 percent ethanol and 15 percent gasoline, would cause more air quality–related deaths over several decades than burning pure gasoline, especially in urban areas like Los Angeles. That's because even though biofuels can reduce greenhouse gases compared to oil, they still produce toxic tailpipe emissions when they burn. In Jacobson's study, the E-85 vehicles reduced atmospheric levels of two carcinogens (benzene and butadiene) but increased two others (formaldehyde and acetaldehyde). Cellulosic ethanol, though cleaner than corn ethanol in production, acts the same once burned as fuel.

Incidentally, the reaction to Jacobson's study also offers a parable about how politicized energy research has become and how big oil money complicates the matter. Jacobson is world renowned for his atmospheric models, but the Foundation for Taxpayer & Consumer Rights (FTCR), an oil watchdog group that has criticized the BP deal, says his work is tainted because a center he once did research for at Stanford received a $100 million contribution from Exxon Mobil for climate research. In fact, Jacobson's recent pollution study was funded by NASA, and he is not invested in any energy companies. But the tense environment shows that no matter how well the UC/BP scientists investigate biofuels, those who disagree will figure out a way to argue that their findings are suspect.

Jacobson is a shy, soft-spoken man, but during our visit, he is clearly angry about the FTCR's accusations. It's easy to see why. Far from collaborating with big oil, Jacobson has conducted groundbreaking research on how to reduce greenhouse-gas emissions by 80 percent, the amount needed to stave off the worst effects of global warming. Instead of cellulosic biofuels, which he and others calculate would reduce carbon emissions from cars by only about 13 percent (some studies say as much as 22), Jacobson sees far more potential in battery-electric cars and plug-in hybrids that run on solar and wind energy. That energy, he says, could also power the electricity in homes and businesses, which contribute a huge chunk of global carbon emissions. (Jacobson himself has solar panels on his house, and he and his wife each own a Toyota Prius.) Jacobson's studies, along with transportation research by UC Davis professor Mark Delucchi—who has done the most comprehensive study on the potential of biofuels—show that about 100,000 wind turbines could power an entire fleet of battery-electric cars, virtually without emissions, for every driver in the U.S. In addition, those turbines would require about one-tenth the land that cellulosic ethanol does.

The biggest criticism of wind is that it doesn't always blow. When I ask Jacobson about this, he gets up from his desk and pulls out a file of graphs, one of which shows the total amount of energy produced by wind turbines in Spain. That country generates 6.5 percent of its electricity from wind (compared with 0.6 percent in the U.S.), and the graph shows sharp up-and-down lines, like those on a heartbeat monitor, but all within a relatively narrow range—and they never drop even close to zero. Jacobson also points out that wind farms could be interconnected through a transmission grid; so when there's no wind on the California coast, for example, wind from the mountains or desert could supplement the shortfall. Solar power could be called in for backup, too.

As for the fear that wind energy is hard to store? Hogwash, says Jacobson. Electric cars can stockpile energy in their batteries and pump it back to the grid when necessary. Nor is he swayed by the argument that it may simply be too hard to build the turbines and transmission system required to make all this work. Harnessing the power of wind, and even converting to electric vehicles, isn't nearly as challenging as trying to make a safe and efficient cellulosic biofuel, he responds. The real reason we're not investing as much in wind is that "research dollars usually follow the biggest lobbies, and the oil and farm lobbies want biofuels to be the answer." After all, the oil companies have the infrastructure for liquid fuels, and what farmer wouldn't be excited about essentially growing oil?

An electric-car economy may seem even more quixotic than one that runs on perennial grasses, but a visit to Tesla Motors brings the idea into focus. The folks at this San Carlos company believe biofuels are already passé and want to convert America to the electric car. With technology that goes far beyond previous attempts, Tesla seems to have a fighting chance of actually doing so. The first thing you see in the company lobby is a glass case of awards: *Business Journal*'s Engaging Technology Award, *Popular Mechanics*' Breakthrough Award, Car-Domain People's Choice Award, 2006 Global Green USA Award, Time magazine's Best Inventions of 2006, *Forbes* Best Cars of 2006. All this for a car that won't be on the road commercially until 2008.

After David Vespremi, Tesla's director of communications, gives me a tour of the garage—full of computer geeks with their heads under car hoods—he takes me for a ride in a deep-red Tesla Roadster, which looks like a cross between a Porsche, an Alfa Romeo, and a Martian spacecraft. Vespremi turns the key, and I can't hear a thing as we take off. Since the Tesla has no internal combustion engine—it runs on an electric motor that could fit in your backpack and an ultra-powerful lithium battery similar to the one in your laptop—it never makes much noise until you give it a little juice. That's exactly what Vespremi does when we hit Highway 101, and in moments we're pinned to the seats by the power of an engine that does 0 to 60 in under four seconds (about as fast as a Porsche 911), but with zero emissions. The sensation is something like flying in a jet with the top down, accompanied by the light hum of a hair dryer. As we weave through traffic on the highway, a Porsche tries to lose us, but can't. "Did you see that guy?" Vespremi chuckles. "He was like, 'What the hell kind of car is that?' Freaking out Porsche drivers is one of our favorite pastimes."

In 2008, about 600 Tesla Roadsters will hit the market. “At that point,” Vespremi says, “everything changes.” George Clooney, Arnold Schwarzenegger, Larry Page and Sergey Brin of Google, and a host of Silicon Valley VCs have already put in their orders. Of course, 600 cars won’t make a dent in U.S. carbon emissions, but they will have a huge impact on the American perception of what’s possible. That’s because Tesla technology brings new options to the electric-car debate.

Previous attempts at building a functional electric car failed partly because the nickel or lead-acid battery packs could last only about 60 miles per charge, relegating the vehicles to commuter shuttles. The Tesla’s patented lithium ion pack, on the other hand, goes about 245 miles on a full charge—still not enough to serve as the only car for most people, but not bad for city dwellers and many commuters, especially when you think about it like charging a cell phone. Plus, lithium ion batteries are slated to double in efficiency within a decade.

Tesla’s engine uses an unheard-of 80 percent of the battery’s energy to power forward, as opposed to gas-powered cars, which waste 80 percent, which is why the Roadster is so damn fast and efficient. This also means that a lithium-powered car can get the equivalent of 135 miles per gallon (about two cents per mile), so a full charge only costs about two dollars in electricity—and if you use solar power to run it, the electicity goes down to almost zero. “My wife and I just had solar panels put on our house,” says Vespremi, “and we figured we’ll be able to drive completely emission-free and pay only $12 per month in electric bills.” Even if the Roadster were powered completely by dirty coal electricity, it would still emit fewer greenhouse gases than any other alternative-fuel vehicle.

And how’s this for a punch line? Tesla vehicles take just a few hours to charge fully, and some hotels around California have already agreed to install charging stations. The company isn’t planning to make only niche sports cars, either. It’s determined to prove that electric cars can do everything an internal combustion engine can do, and then some—at a competitive price. The Roadster currently sells for $98,000, but in a few years, Tesla will release an electric sedan in much greater numbers that will sell for around $50,000. If all goes well, the company hopes to eventually introduce a car that it can manufacture on an even larger scale and sell for somewhere in the neighborhood of $30,000.

The chairman of Tesla Motors, Elon Musk, who cofounded PayPal and also chairs the rapidly growing solar-energy company Solar City, expects Tesla to be worth billions someday. (He and other investors, including the Google boys, Jeff Skoll, and Steve Westly, have already sunk more than $100 million into it.) In a company slide show that emphasizes how critical Tesla believes its role in the new economy will be, the closing quote is from Sheikh Ahmed Zaki Yamani, the former Saudi oil minister: “The Stone Age came to an end not for a lack of stones. And the Oil Age will come to an end not for a lack of oil.” If Tesla had its way, the biofuel age wouldn’t even have a chance to begin.

The UC/BP deal was supposed to have been signed by last August, but as of press time, it remained stalled in negotiations. Protesters have continued to organize rallies and started distributing free T-shirts that say, “I didn’t enroll in UC/BP.” The UC administration said the deal was merely hitting bureaucratic speed bumps, but some observers wondered if the delays resulted from BP’s asking for more patent rights than UC was willing to give. Professor Keasling, meanwhile, has resigned from the lab’s management team to focus on running the DOE lab. Somerville is still slated to direct the EBI; to prevent conflicts of interest, he has resigned as an officer of his biotech companies, including LS9 (though he retains some investments in their stock, which the university apparently has no problem with).

Only time will tell if next-generation biofuels will be remembered as a savior, an overhyped concept, or a source of pollution tacked onto a long list of other bad options. But one thing seems clear: the potential negatives of a biofuels economy, alongside the alternatives that bio-fuels may eclipse, should ensure that UC, the public, and the media keep vigilant tabs to ensure that the research coming out of the UC/BP lab actually greens the planet—not just the pocketbooks of the major players. If biofuels go the way of DDT or leaded gasoline, Berkeley could well end up on the wrong side of history. For now, all the players seem well intentioned. But as the lab’s ethics overseer, Dean Kammen, tells me, “The risks are large, and greed is a real problem.”

Keasling and Somerville seem to maintain at least a semblance of healthy skepticism about biofuels and big-oil funding. They realize BP doesn’t have the best environmental record, but, says Keasling, “We have to help them do better.” Both professors also point out that even if the cellulosic technology they obsess about evolves rapidly for cars, other technologies—solar, wind, battery-electric, hydroelectric—will have to come into play to make a real dent in our carbon footprint. “Our best opportunity is conservation,” Somerville says during a ride in his Honda hybrid. “We’ve got about 40 years left of oil, 60 of natural gas. There’s no time to waste.”

The DOE is optimistic about a cellulosic biofuel economy: it has set a goal of making the fuels cost-competitive by 2012. But neither Keasling nor Somerville is willing to risk any firm speculation about when these fuels might reach the market. “Look, we have a lot of work to do,” admits

Keasling at the close of our interview. “And to be honest, we could be a long way off from success.”

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11 things you need to know about the UC-BP deal

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