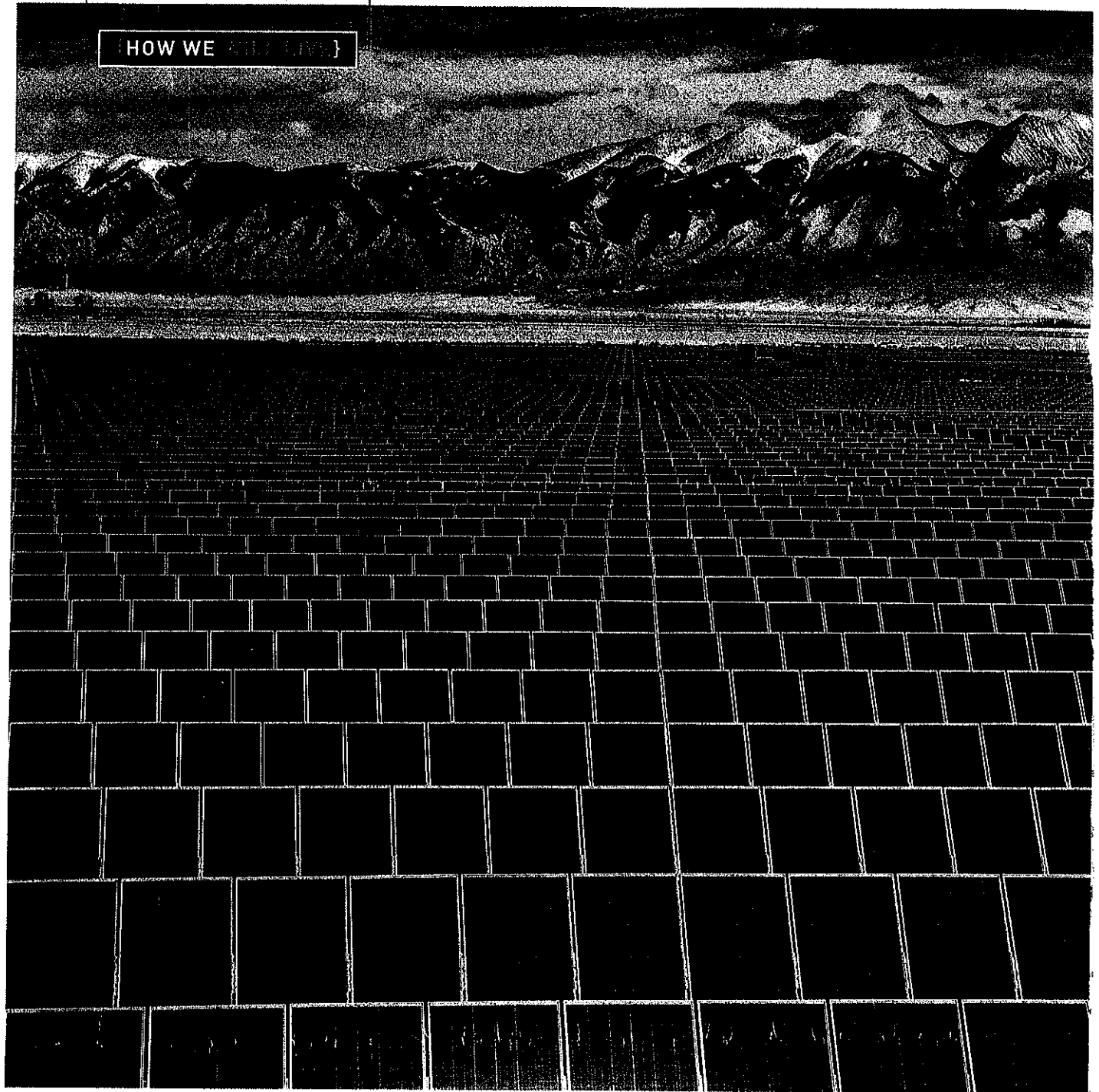


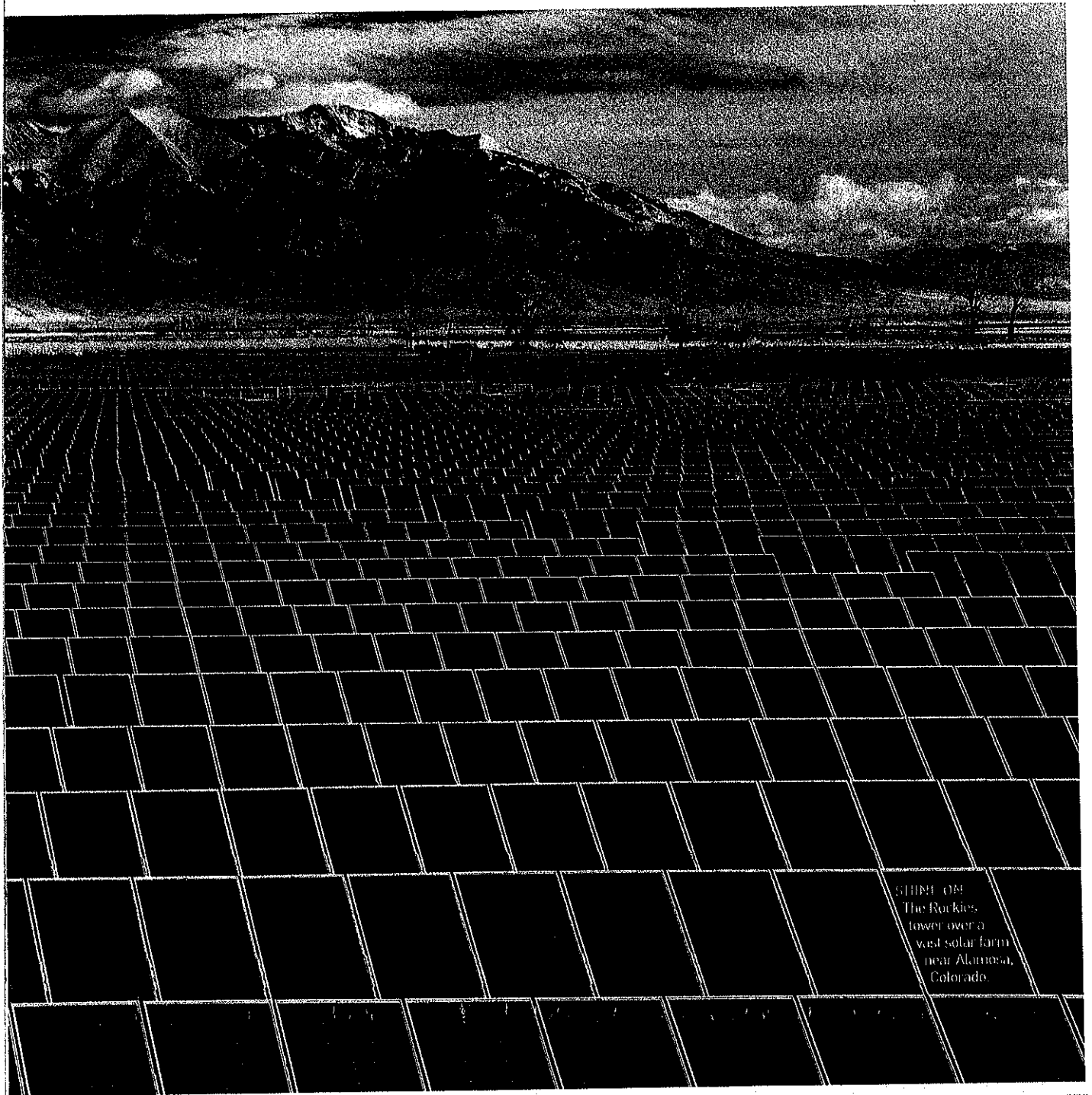
HOW WE



Selling the Sun

A MAN, A PLAN, AND THE DAWN OF AMERICA'S SOLAR FUTURE

BY MICHAEL BEHAR



SHINE ON
The Rockies
lower over a
vast solar farm
near Alamosa,
Colorado.

“I am a capitalist,”

entrepreneur Brian Schatz, the 39-year-old founder of SunDillon. We have his signature and a check for \$1 million that reads “SunDillon, LLC.” SunDillon is a solar farm near Alamosa, Colorado, that has been the subject of a lawsuit filed by a local utility company. Schatz says the utility company is trying to force him to sell the solar farm to them. He says he has been in court with them for months. He says he has been in court with them for months. He says he has been in court with them for months.

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But Schatz is not the only one who's been in court with a utility company. In 2003, SunDillon was the first solar farm to be built in Colorado. It's a solar farm that's been in court with a utility company. It's a solar farm that's been in court with a utility company. It's a solar farm that's been in court with a utility company.

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solar farm can cost anywhere from \$10,000 to \$10 million. This infuriated Shah, who has always believed that having to own the means of producing solar power is woefully out of step with how the energy industry operates. "Do you want to be in the power-plant business?" he asks. "Or do you just want to buy solar power?" Imagine having to own and operate a satellite to get DirecTV and you begin to understand why Shah scorned the prevailing model for solar energy.

A born pitchman, Shah is impossible to ignore during his spiel. When he cold-called Mark Buckley, vice president of environmental affairs for Staples, to make a case for SunEdison, the VP told Shah he'd give him two minutes. "Two hours later I got off the phone and we'd hammered out the beginnings of a deal," Buckley recalls. "He is a visionary."

Shah has acute features: a square jaw, a sturdy nose, and a tsunami of ebony hair. His wire-rimmed glasses frame deep-set brown eyes that demand attention. During our meal I notice diners leaning closer to hear Shah, whose speech is imbued with the confidence and vigor of a man who knows that he knows more than you do. I doubt they can make out what he's saying through the din, but they're sure it must be important.

For Shah's part, he didn't invent any groundbreaking technologies. He just repackaged ones that already existed and convinced people to buy them. SunEdison customers pay nothing for their solar systems. That's right, zero. Instead they sign what is known as a power-purchasing agreement, or PPA. These agreements are commonplace in the coal, oil, nuclear, and natural gas industries (the Hoover Dam was financed in part with PPAs). But Shah figured out how to make PPAs profitable for solar, something that nobody had been able to do before. When SunEdison installs a solar array, the customer agrees under a PPA to buy the electricity it produces at a set price for at least 10 years. "When we priced out owning the system ourselves, it didn't make sense," Buckley tells me. "We wanted a way to establish price certainty in a volatile market. SunEdison gave us a long-term hedge against that price uncertainty. We're paying less for electricity and reducing our carbon impact. And 15 years down the road, when the price of electricity is higher, the savings will be even more attractive."

A spokeswoman for the Kohl's department store chain, which has SunEdison arrays on the rooftops of 67 of its stores, puts it this way: "There was no capital investment, and Kohl's pays a fixed, predictable rate for its electricity that is less than the local utility rate. This gave us an important hedge against escalating energy costs."

The average solar installation produces enough power to meet between 10 percent and 20 percent of a typical big box store's annual energy needs. That may seem small, but traditional electricity

pricing—in which power purchased from the grid during peak-demand hours commands a premium—works in a solar user's favor. A solar array reaches its maximum potential between noon and 4:00 p.m., supplying more than 75 percent of a store's daytime energy consumption and dramatically reducing the need for grid-supplied electricity when it is most expensive. "Peak demand charges might represent a third of our bill," says Buckley of Staples. "So the savings really add up fast."

Once Shah has locked in customers through PPAs, he can then approach banks, investment firms, and private backers to borrow money for building new solar systems, using those PPAs as collateral. Revenue collected through PPAs goes directly toward repaying SunEdison's lenders, who earn a tidy return on their dollar, pocket city and state solar rebates, claim an accelerated depreciation benefit, and take a federal investment tax credit, a whopping 30 percent write-off. Banks, in turn, pay SunEdison a development fee and cover the cost of monitoring and

servicing the installations for the duration of each PPA. Mark Cirilli, managing director of MissionPoint Capital Partners, one of the first venture capital firms to invest in SunEdison, says, "They simplified solar and made going green easy and cost-effective—a real win-win."

Solar is reliable and robust, and by selling it through PPAs, Shah has created something the market finds irresistible: clean, renewable energy with no up-front equipment costs, packaged as the kind of rock-solid, low-risk investment that banks love. And now, as solar scales up and the cost of installation falls, Shah and others are convinced that the Obama administration's new policies will bring solar to a tipping point, making it competitive with conventional fossil fuel-generated



THE SUN KING Jigar Shah founded SunEdison in 2003 and in six years turned his tiny start-up into the largest provider of solar power in the United States.

grid power and turning it into a formidable player in the mainstream energy market for the foreseeable future. Shah says that "2009 will be the year of solar." And from there? Energy experts believe that continued increases in the efficiency of panel manufacturing and installation as well as the emergence of utility-scale installations will soon make solar cost-effective not only in states where grid power is expensive, but across the entire nation. When that happens, the solar industry will thrive without a single tax credit, subsidy, or incentive—a feat that has never been achieved with any other form of energy.

IN 1975, when Shah was just a year old, his father, Hasmukh, a physician, moved the family from Gujarat, in India, to Chicago. Seven years later they moved again, 100 miles west to Sterling, Illinois, a whistle-stop on the Rock River. Shah discovered solar when he was 16. "I read a book, though I can't remember what it was called because I'm not a pack rat and probably got rid of it as soon as I finished it," he says. "But for some reason, I got solar stuck in my head, and it just stayed there." In high school he queried his teachers, wondering what he should study in college that would help him to get into the solar business. They were clueless. Shah visited the University of Illinois at Urbana-Champaign for an informational interview. An adviser there suggested mechanical engineering. "I wasn't really an engineer by personality," he confesses. But at the time solar was a technology, not a viable business, so Shah attended the university and earned an engineering degree.

Shah took his first solar job, a summer internship between his junior and senior years, at AstroPower in Newark, Delaware. The company designed photovoltaic panels and made several key advances in the production of low-cost, silicon solar cells. (AstroPower filed for bankruptcy in 2004 and was acquired by General Electric.) Even then, in 1995, Shah was contemplating how to reinvent the solar industry. "When I was at AstroPower, I recognized that individuals couldn't come up with the money to install solar. It was clear everyone wanted it, but nobody wanted to pay for 20 years of electricity up front," he says. Shah also did a stint at a wind power company and faced the same problem. "I would get calls from farmers wanting to put up wind turbines in their fields, but when I told them it was \$100,000, they lost interest."

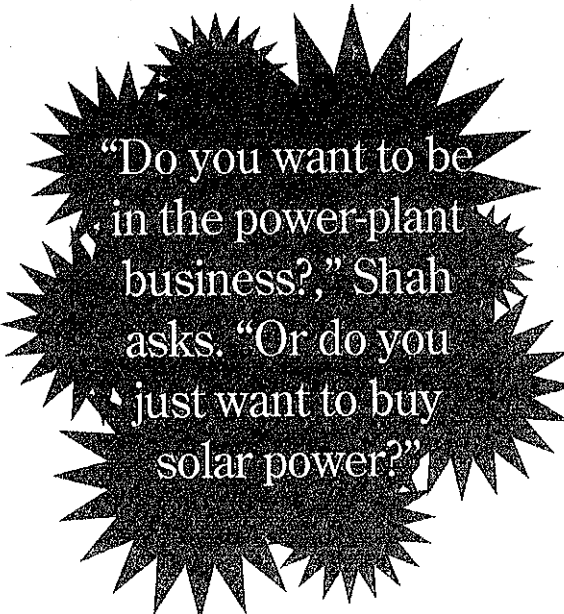
It wasn't until he enrolled in an MBA program at the University of Maryland in College Park that academics engaged Shah meaningfully. "I'm a business guy at heart," he says. Shah wrote the plan for SunEdison while in graduate school, as part of a entrepreneurship class. "When my professor gave me an A, I thought maybe I had a pretty good idea. But the dot-com boom was going on, and people didn't want to invest in solar. It was much easier to give someone a couple hundred thousand dollars to put up a Web site," Shah says. He shelved the concept and, shortly before graduating, joined BP Solar as an analyst.

"I pitched my idea to BP a couple of times, but they didn't have much interest either." In September 2003, tired of waiting, Shah, who had been put in charge of BP's commercial sales in North America, left the company. He took out a \$93,000 line of credit on his home and embarked on a journey that would transform the solar industry.

SunEdison began inking deals almost immediately. By the end of the year Shah had already locked in PPAs with Whole Foods and Ikea, and Staples signed on the dotted line in early 2004. Lining up customers was the easy part. "We quickly got into a situation where we had all these customers but needed to find financing," Shah says. He started pitching anyone he thought might be willing to gamble a few million dollars on his solar dream, including investment banks like Goldman Sachs, which was already financing similar deals to build wind farms.

Shah felt that investors should give him money at a lower interest rate because solar was considerably less risky than other energy

projects. In meetings, he evoked the teachings of the late Shimon Awerbuch, a renowned economist whose forte was energy markets. "Awerbuch often asked why investments in renewable energy projects were expected to get the exact same rate of return as natural gas and coal, when gas and coal are more risky," Shah says. Solar is much lower risk, his argument goes, because once you pay for the equipment, the sun is free and maintenance is low. A coal-fired power plant spends 20 percent of its life span off-line, undergoing repairs. For solar, that figure is less than 1 percent. "The amount of sun that hits a specific spot on earth varies by only 4 percent each year. It's very stable, very secure," Shah points out. The same can't be said for other sources of power. Not only do you need mountains of cash to design, build,



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operate, and maintain power plants that run on fossil fuels or nuclear fission, but you also need the fuel itself. Coal will last about 300 years. Oil might make it another century. Natural gas could squeak by until 2080, right around the time that uranium ore becomes impossible to mine using today's methods of extraction. The best ballpark estimate has the sun burning hot for another five billion years.

"I went to a bunch of investors and explained all this to them, and they laughed at me. They didn't care what Awerbuch said," Shah recalls. They just wanted the same rate of return they were getting on their other energy projects. This confounded him. But solar PPAs were a nascent, unproven concept, and most lenders couldn't care less about advancing the technology. For them, this was about securing profits, not saving the world.

Shah zealously pursued Goldman Sachs. "They said to me, 'Okay, we get your thesis, but we still want our standard rate of return,'" he says. Left with no alternative, Shah found a way to make it work. He structured his agreements to make the investors the legal owners of the solar panels, which SunEdison would acquire, install, and maintain on their behalf. This qualified investors for solar rebates and federal tax credits that, when combined with the income guaranteed under

the PPAs SunEdison signed with its customers, added up to a package that met Goldman Sachs's financial demands. In June 2005 the bank gave Shah \$60 million. Soon afterward he secured funding from HSH Nordbank, the Bank of Hawaii, and Wells Fargo, and then another \$26 million from Goldman Sachs in 2006.

Now that SunEdison is starting to look more like a utility company than a scrappy start-up, Shah is moving on. Shortly before we met in Washington, D.C., he decided to part ways with the company he founded.

"Ultimately the institutionalization of the business, while he knew it was necessary, narrowed his role and led to his leaving," explains Mark Cirilli of MissionPoint Capital, whose firm remains invested in SunEdison. "Jigar is a very talented, visionary entrepreneur, and typical of most business starters, he was happier in start-up mode than in growth mode."

Shah tells a similar story. "My own strength is building something new and innovative and solving problems that people think are unsolvable or intractable," he says. "SunEdison doesn't have those problems, and the adrenaline rush is gone because I accomplished what I wanted to do." Shah remains a major shareholder in SunEdison, though he wants me to know, "I didn't start SunEdison to become wealthy; I started it because I wanted solar to be successful." As for what's next, Shah's not telling. "At the advice of my wife," he says, "I'm taking a few months off just to do house husband things."

ON A BRISK winter morning in December, I tour one of SunEdison's newest solar farms, located in Golden, Colorado, at the U.S. Department of Energy's National Renewable Energy Laboratory (NREL). The five-acre installation, completed only days before my visit, is built atop a hard-scrabble mesa called Table Mountain that faces westward toward the snow-clad Rockies. Aligned in precise rows are 3,696 solar panels mounted on steel trestles. Each row is coupled to a driveshaft. Every 15 minutes, small electric motors spin the shafts, and the panels rotate about two degrees to track the sun across the cerulean Colorado sky. "This cost us nothing to build. We just purchase the electricity," says Gregory Collette, acting director for laboratory operations at NREL, which signed a 20-year PPA with SunEdison. Collette leads me into a muddy clearing, where Bobby Matthews, a SunEdison superintendent, is waiting to show us around. "You'd be amazed at how much solar energy these panels can receive even when it's cloudy," Matthews tells me.

This is a guy who loves his job. Matthews eagerly describes the pneumatic drill required to bust through cap-rock basalt in order to embed anchoring posts. He enthuses about DC inverters, high-pressure gas lines, and greaseless gearboxes. In 2007, Matthews spent three months with a crew of 80 workers constructing an 8.2-megawatt, 80-acre SunEdison solar farm near Alamosa, Colorado. Built for Xcel Energy, it was the largest solar installation for a major utility company in the United States. "Man, that was a really fun job," he recalls as we continue our tour.

TRACKING PROGRESS SunEdison's Alamosa facility, top, has sun-tracking panels that can be 40 percent more efficient than fixed panels, such as those on the roof of this San Diego water treatment plant, bottom.

The \$7 million NREL facility that surrounds us can withstand 120-mile-per-hour winds, requires almost no maintenance, has a capacity of 720 kilowatts, and is able to supply about

7 percent of NREL's annual energy needs. "Today we're paying SunEdison the same rate we were paying the local utility," Collette informs me. "And we are insulated from any future rate increases."

At the NREL installation, the silence is striking. Aside from the periodic whir of tracking motors and a faint hum from a nearby transformer, the entire operation cranks out clean, green electricity without a peep. A family of deer wander into view, oblivious to the fact that they're grazing next to a quarter-mile-wide photovoltaic powerhouse. This is Shah's legacy, duplicated elsewhere in Colorado and at sites in California, New Jersey, Connecticut, Rhode Island, and Hawaii. Today, SunEdison operates about 200 commercial installations in the United States, with a total capacity of 60 megawatts—enough to power about 48,000 homes or a city the size of Ames, Iowa. In addition to Staples, Whole Foods, and Kohl's, its roster of clients includes Costco and Wal-Mart as well as car dealerships, universities, research parks, hospitals, federal agencies, municipal governments, utility companies, and self-storage warehouses.

When evaluating a particular site, SunEdison engineers choose from more than 40 solar products. "It's important to have a number of arrows in your quiver," says Mark Culpepper, the company's chief technology officer. "I don't think any one technology is going to be the best," he says. "If it's on a rooftop with space constraints, we might go with a high-efficiency panel. If it's on a ground mount where space is not a concern, we might opt for a thin film. If the rooftop is load constrained, we might go with a lightweight substrate and thin film." SunEdison monitors the technologies at its sites and has accumulated what Culpepper says is the world's largest collection of solar performance data. Lenders give SunEdison a bonus whenever an installation exceeds its anticipated power output, "an incentive to make sure we keep the systems running in top condition," Shah explains.

Two similar companies, Sungevity and SunRun, have sprouted from SunEdison's roots, marketing PPAs to homeowners. The residential sector of the solar industry was valued at \$2.5 billion in 2007 and is expected to grow to \$39.3 billion by 2014, spurred in part by the push to use rooftop solar arrays to power plug-in hybrid vehicles. It's a market that SunEdison has not sought to tap into. "Why bother with residential when the commercial market has so much potential?" Shah asks. Utility-scale installations are another story—and a promising one. The \$700 billion Wall Street bailout (the Troubled Asset Relief Program) passed last October extended the federal tax credit to utilities, which were previously prohibited from taking it. For SunEdison, having already honed its expertise in designing and building large-scale solar installations, utilities represent a fertile, untapped market.

Some argue that utility companies will go it alone. "It makes sense for them to own the solar farms, just like they own the coal-fired power plants," contends Brian Fan, senior director of research for the Cleantech Group, a market research firm that focuses on renewable technologies. SunEdison's Culpepper sees things differently. "Utilities don't have core competency in distributed generation, so they'll look for partners," he says. "It's one thing to have a handful of power plants to manage. It's another to have a fleet of 10,000 power plants to manage—and that is really the scale we're talking about with solar." No one knows whether utility companies will favor the PPA model or opt to pay for solar themselves and thus be able to offset expenditures with federal tax credits. In the larger sense, it doesn't

much matter whether SunEdison gets into the utility game, or whether utility giants decide to venture into solar on their own. It's a shift away from fossil fuels toward clean, renewable energy, and the result is still good for the planet.

IN DECEMBER, as bailout negotiations for the auto industry wore on and the U.S. economy continued its downward spiral, the National Renewable Energy Laboratory published a report that examined the history of investment in the solar industry. Its pages are chock-full of encouraging data. One tidbit in particular is a jaw-dropper: from 2000 to 2007, worldwide investment in solar rose from \$66 million to \$12.4 billion. During the last three years of that time period, investments in the United States alone jumped from \$215 million to \$3.2 billion—a whopping compounded annual growth rate of 145 percent. And in just one year, 2006, global private equity investments shot up 476 percent. Historical data won't allay anxieties about solar weathering the current economic crisis, but another report released that same month ought to: the market research firm AltaTerra found that 72 percent of commercial solar installations are now financed with PPAs. AltaTerra analysts David Adams and Jon Guice assert that despite dark financial times, "The next decade is likely to see the solar PPA enter a period of hypergrowth, with PPAs playing a central role in the expansion of solar power as a mainstream part of business energy portfolios in the U.S."

With the adoption of the PPA model—Shah's genius—solar has experienced staggering growth. It's now poised to benefit even more from an oversupply of raw materials. In 2007, polysilicon stockpiles dwindled when solar panel manufacturers churned through more of it than the entire microprocessor industry, an unprecedented event. Because the cost of solar panels is primarily determined by the going rate for polysilicon, the sudden shortage caused panel prices to soar. Major polysilicon manufacturers responded, and within months they had broken ground on new plants around the world dedicated entirely to producing polysilicon for photovoltaic arrays. These facilities are gearing up to full capacity and will double the supply of polysilicon over the next several years. At the same time, semiconductor sales are expected to fall by 6 percent this year, leading to further decreases in the price of polysilicon.

"All this is happening at a time when the world is going into a heavy economic retrenchment," SunEdison's Culpepper says. "The net effect is a ballooning of supply at a time when demand is not able to keep up with that supply."

Of course, solar companies are not immune to the challenges posed by the economic recession, particularly those firms that

signed expensive, long-term supply contracts for polysilicon when prices were high. Though individual companies may fail over the coming years, Cai Steger, a policy analyst for the Center for Market Innovation at the Natural Resources Defense Council (NRDC), remains confident that the industry as a whole will flourish. He says that we are now entering a period that "will be very good for policy makers and consumers, who want to install the cheapest panels possible in the most possible places."

As the price of solar panels drops, companies like SunEdison will see their profit margins widen, and this will allow them to forage for customers in new markets—states with fewer incentives and rebates, for example, or places where low-cost electricity has made it hard to compete. Among the progressive energy policies that will surely give solar a leg up are state-mandated renewable energy portfolio standards, which require that utilities generate a certain percentage

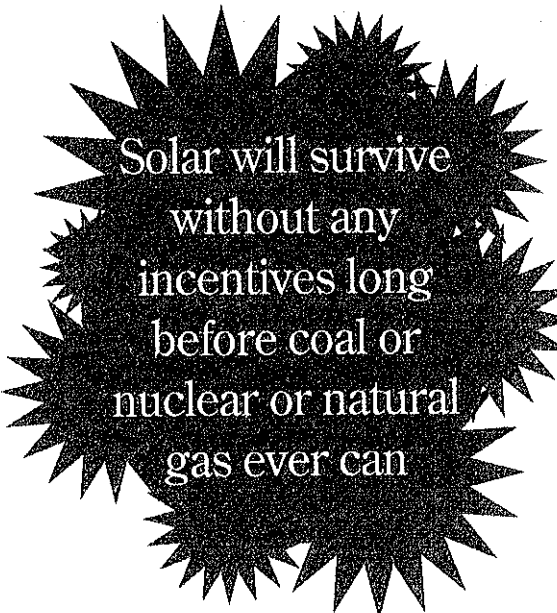
of grid power with renewable technology. So far, these standards have been passed by 26 states, including California, Texas, Pennsylvania, New York, Missouri, Illinois, Maine, Virginia, and North Carolina.

Solar may get another push from legislation that increases the cost of burning fossil fuels. President Obama has promised to implement an economy-wide cap-and-trade program to reduce greenhouse gas emissions by 80 percent by 2050. If that happens and you're a utility using fossil fuels to generate electricity, you'll have to pay to pollute. And you'll probably pass on those costs to the consumer. In this scenario, grid power from fossil fuels gets more expensive and solar starts looking mighty attractive.

"Americans believe they have a right to low-cost stuff. So when solar is cheaper than other forms of power, Americans will demand the ability to use it," observes Alisa Gravitza, director of Green America, a nonprofit that promotes sustainability.

At the moment, solar is subsidized: tax incentives and rebates gave Shah the boost he needed to develop a viable business model for SunEdison. But critics complain that solar couldn't survive without subsidies and therefore isn't truly ready to share a seat at the adult energy table. During my dinner with Shah, I bring up the subject, reminding him that a faithful capitalist would eschew taxpayer hand-outs. "Energy is the most subsidized commodity in the whole world and has never been an open capitalist market," he responds. "The coal industry gets incentives, the oil industry gets incentives. The U.S. government spends billions of dollars each year protecting the Straits of Hormuz and all the oil shipping channels with the U.S. Navy. The nuclear industry has received \$66 billion in incentives since the 1960s. Imagine what solar could produce with \$66 billion!"

He's right. According to the International Energy Agency, solar received \$198 million in subsidies in 2007. In the same year, oil and natural gas collected \$2.1 billion; coal got \$3.2 billion. Taxpayers have



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bankrolled fossil fuels for a century, funding research and development and helping dirty energy stay cheap. Remove subsidies, and gasoline would cost at least \$8 a gallon.

It may be true that these incentives paid the price discrepancy between solar and conventional grid power today, but industry insiders maintain that solar will outgrow these subsidies. They believe that advances in panel efficiency, low-cost polysilicon, the escalating price of grid power, improved manufacturing techniques, and carbon-cap legislation will make subsidies unnecessary and even potentially harmful. "Industries can get addicted to subsidies," NRDC's Steger says. "Phasing out subsidies forces the industry to innovate and make its systems cheaper to stay competitive."

Analysts will say that scale is far more beneficial to solar than subsidies are. The formula is simple: the more solar is installed, the cheaper it gets, and the cheaper it gets, the more it is installed. "By 2015 it will be a compelling way to generate electricity almost everywhere," Steger says. "We're still learning how to manufacture and install panels as efficiently as possible," he explains, citing studies that show that every time installed solar capacity doubles, costs fall by 18 percent to 23 percent. Graetz agrees: "Solar will survive without any incentives long before coal or nuclear or natural gas ever can."

First Solar, the largest maker of photovoltaic panels in the United States, proved this to be true for its client Sempra Energy, a California-based utility company. "First Solar priced their Sempra system at 7.5 cents a kilowatt-hour, which is better than the U.S. grid price of 9.4 cents...and with no subsidies," energy analyst Mark Bachman wrote in a report for Pacific Crest Securities, an investment bank that funds emerging technologies. One way First Solar was able to cut costs was to improve panel efficiency so installations didn't need expensive tracking mechanisms to synchronize the arrays to the movement of the sun. First Solar achieved what's known in the industry as grid parity, which means generating electricity at rates that are on par with the price of conventional power. In California, where electricity is expensive, solar can outcompete fossil fuel-generated power. The same holds true for Hawaii, where grid power is pricey and sunshine is plentiful. "Every year more and more states become cost-effective," Shah says. "We have already reached grid parity for most of the country when you factor in the cost of building new natural gas, coal, and nuclear plants."

Steger estimates that solar will reach parity with retail electricity rates nationwide within the next several years. Today solar generates

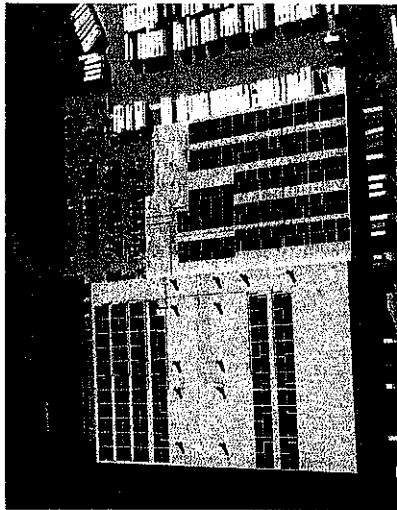
a mere four-tenths of a percent of electricity in the United States, but if the industry's growth continues along its current path, its share of electricity generation could hit 10 percent by 2025. Could we get to 20 percent? "Probably," says Rick Duke, director of NRDC's Center for Market Innovation. "Solar is available for at least six hours a day, at a time when there is also a lot of consumption." To get from 10 percent to 20 percent, we'll need to jump some hurdles. Photovoltaic panels can generate electricity only during the day. They work best when the sun is shining brightly, less well on dark, overcast days. If we could somehow sock away electrons during sunny spells, we could use solar power 24/7. But battery technology at that scale remains ridiculously expensive: stored solar would cost more than \$1,000 per kilowatt-hour.

One solution is to leverage the next generation of plug-in hybrid vehicles as roving storage devices. Think big batteries on wheels. Graetz explains how this might work: "You drive to the office and plug your car into a solar system, which fills the battery. At the end of the day, you drive home. There's enough solar in your battery to run the lights and computers and televisions in your house. In the morning you drive back to work and do it all over again."

Right now, however, storage isn't a big worry. "You're talking at least 15 to 20 years before we're producing more solar power than we can use on the spot," Steger says. "Until then, storage is not a concern." By the time that happens, the solar power industry will have grown to the point where it has created a much-needed wedge in the fight to stop global warming and diminishing our reliance on foreign energy. Anything beyond that would be gravy.

The dismal global economy may deliver quite a beating to some solar companies over the next year or two, but what's important is that the industry seems on track to prosper over the long haul. This hardly surprises Shah, whose faith in solar is as unwavering as his confidence in the market to fix our ailing planet, the cure springing not from the MITs of the world but from the MBAs.

"The big area for me has always been to come up with business solutions to address global warming," Shah says. "The thing that people have had a hard time understanding about solar is that it's part of the energy business. While new energy technologies come up all the time, technology is not the driver of the energy industry. The driver is the business model: how you get it financed and how you apply traditional risk-management methods to solar and wind and biomass. That to me is the key to solving global warming."



DELIVER US In 2007, when SunEdison built this solar array on the roof of Staples' Killingly, Connecticut, distribution center, it was New England's largest—the size of 1.5 football fields.