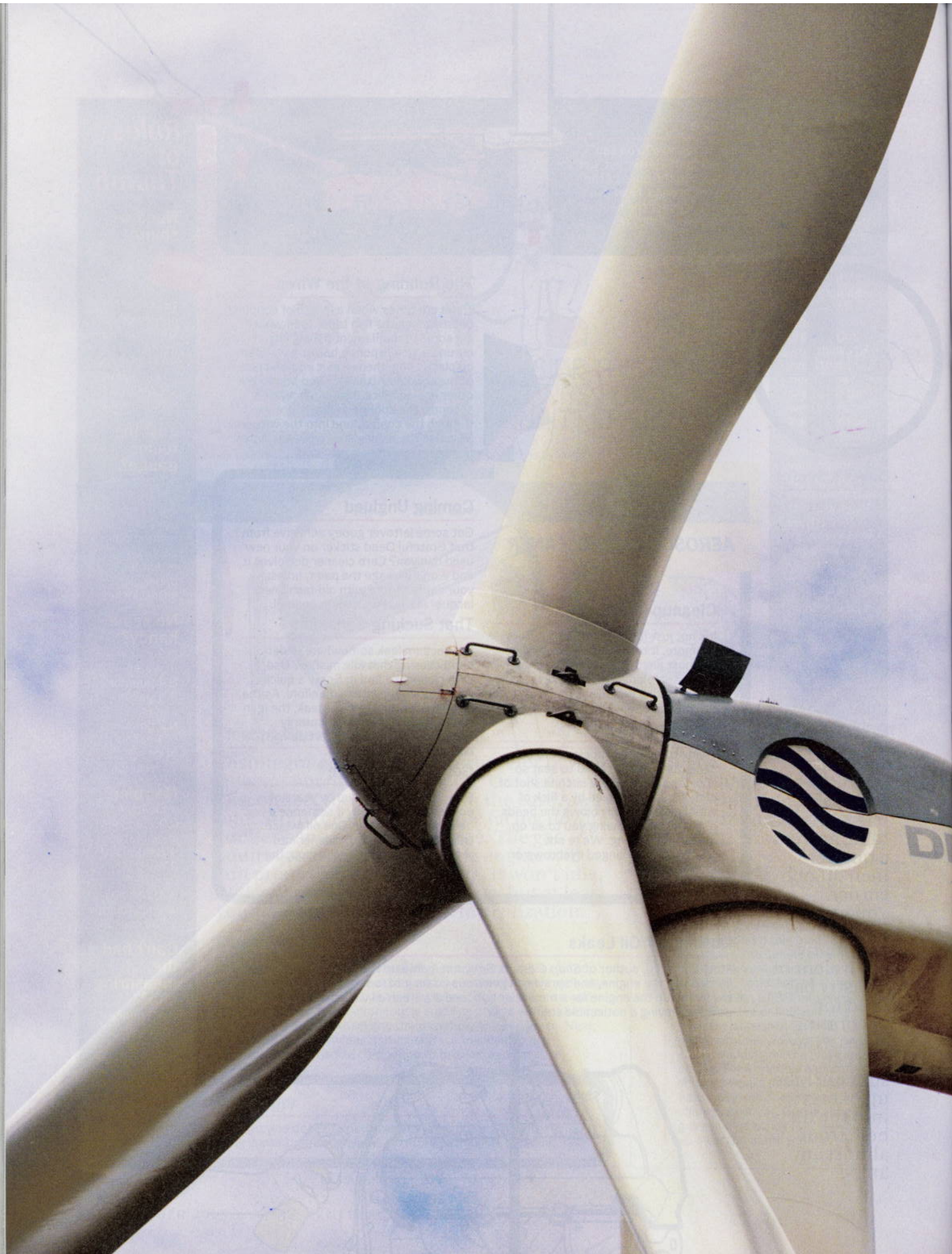

The New Wildcatters

Texans' oil-boom attitude could put the state in a surprising position—leading the charge to alternative energy.

By Jennifer Bogo

Photographs by Jason Fulford

Dan Templeton stands on the nacelle of a 2-megawatt DeWind turbine in Sweetwater, Texas. Four of the world's five biggest wind projects are in Sweetwater's Nolan County.

Driving along Broadway in Sweetwater, Texas, one could justifiably assume the city is on its way down, not its way up. Cobwebs crowd the windows of abandoned storefronts, and peeling signs hang from cracked facades. It is only after I pull up to the mayor's office, pausing to study the street more carefully, that I notice a real clue to the city's changing fortunes: The blond stone building is neatly sandwiched between Craig A. Johnson, Independent Petroleum Landman, and Evans Enterprises, "Your source for wind turbine maintenance solutions."

Greg Wortham, the mayor of Sweetwater, is a compact man who, contrary to his West Texas roots, speaks quickly and easily, offering more information than is asked. As we

leave downtown in his silver Ford Escape Hybrid, he points to one low-slung building after another. "That's a British company, Altezza. They work on the outside of the blades and towers, like spacewalkers. That building had been vacant for a dozen years, easily. This is General Electric—there's 150 workers there. It used to be a Coca-Cola storage facility. At one point, a quarter of all GE turbines in the world were built here. Northwind moved into that one; it held a company that made deer blinds."

Along the narrow state road, warehouses evolve into wide-open plains where Black Angus cattle meander among the bases of sleek white turbines. I have to crane my neck in order to take them in. When the blades revolve to 12 o'clock, the turbines stretch to a height twice that of the Statue of Liberty and sport a wingspan greater than a 747's. As I peer out the window, Wortham identifies turbine models the way a bird-watcher ticks off species: The nacelles of Mitsubishis appear to have two eyes and a mouth on the back, he tells me. Siemenses have a tail fin and are long and sleek like a bullet; General Electrics are shaped like a breadbox and Vestas turbines are cut across the bias with a clean diagonal line.

The irony of this scenario in a state better known for its drilling rigs is not lost on Wortham. "If you picked 50 states, plus D.C., and asked anybody in the U.S. to rank all 51 [for wind power], Texas would be somewhere around Mississippi," he says, "at the bottom."

Since the Spindletop gusher inspired the first wave of wildcatters in 1901, Texas has had a history of going all out in the energy business—but not in ways that are necessarily friendly to the environment. If Texas were a country—and Texans love to remind you that it once was a sovereign republic—it would rank seventh in carbon-dioxide emissions: Its economy accounts for more than a quarter of total U.S. natural gas production and oil refinery capacity, and its residents consume up to three times as much energy as residents of neighboring states.

If it were a country, Texas would also rank sixth in wind power, after Germany, the U.S. as a whole, Spain, India and China. While U.S. wind-power capacity grew by 43 percent in 2007, in Texas it rose by 57 percent. All told, the state's turbines now produce more than 8300 megawatts of electricity, enough to power about 2 million homes; nearly 3000 are produced in Sweetwater's Nolan County alone. In comparison, Vermont produces 6 megawatts; Oregon, 1408. Even California generates just 2781 megawatts from wind power, and it built its first wind project nearly three decades ago.

And that is the curious paradox of Texas: While seemingly more virtuous states labor over environmental impact assessments, Texans see a business opportunity and grab it—and so could very well end up leading the nation in clean energy. "In Texas, because we don't care about the environment, we're actually able to do things that are good for the environment," says Michael Webber, assistant professor of mechanical engineering at the University of Texas at Austin. "It's the most ironic, preposterous situation. If you want to build a wind farm, you just build it."

On private land, wind developers simply make a deal with landowners and pay them a royalty. But there's no siting review process for wind farms on state lands, either. Plus, the state's boundary extends 10.3 miles from the coast, a stipulation made by Sam Houston, Texas's president, before the republic joined the United States in 1845. Federal waters off all other coastal states begin 3 miles offshore, which means wind projects beyond that point—such as Cape Wind, which was proposed for Nantucket Sound in Massachusetts in 2001—fall under the jurisdiction of the Minerals Management Service.

"If you'd like to build a wind farm off the coast of Texas, you only have to deal with the Texas General Land Office, and we're a very eager leaser," Jim Suydam, the office's press secretary, says. "My boss is a Texas Republican. He's an old Marine lieutenant colonel who carries a gun in his boot. But you'll find no bigger proponent of offshore wind power, because he sees it as a vital part of a diversified revenue stream for public education."

Offshore oil and gas production have contributed $6 billion to the Texas Permanent School Fund since it was established in 1854—but that source of income won't rise forever, Suydam says. So this summer the Texas General Land Office signed two offshore wind leases with Houston-based Baryonyx; they were the state's sixth and seventh. When the company goes into production, the state will take a cut—and resell the power. "It's different than in California, where it's all about carbon emissions," Suydam says. "Here it's all about making money."

Heat rises. So inside the cramped nacelle of a 2-megawatt wind turbine, 260 feet above the West Texas plains, it's easily 100 F—hot enough to give the gearbox a mirage-like haze, to cause my fingers to fumble clumsily

Wind and Cotton

"Because there are so many landowners here, nobody gets rich out of this deal," says Cliff Etheredge (left), whose son Scott farms cotton on land in Roscoe. "It's just a small, steady income. If you take care of it, it'll put your kids through college and help pay debts. It's certainly a stabilizing influence on the economy."

Carbon Recycling

The Sunrise Ridge Algae pilot plant takes advantage of a copious resource: carbon dioxide. The gas is siphoned from the top of a stack at the Hornsby Bend Wastewater Treatment Facility in Austin, then pulled through a series of demisters and compressors (below). The CO_2 percolates into reactors downslope where it feeds algae, later processed into biofuel.

with simple carabiners and to make the last few rungs of a narrow steel ladder feel interminably long. But just 10 feet higher, thermodynamics change. A strong, cool breeze blows steadily through the rope tethering me to the top of the hub, around the carbon-fiber blades that taper off into the blinding sun. I shade my eyes and look to the horizon: Neat rows of turbines spin steadily—an alternative energy crop thriving in America's petroleum heartland.

Dan Templeton pops his head and shoulders up through the hatch to triple-check that my harness is clipped in. As a wind technician, he has climbed hundreds of such towers; his rangy body can go from 0 to 300 feet in about 10 minutes. "This job has a certain romance to it because you're working at such heights—there's some perceived danger," says Templeton, who now runs a program to train future technicians at Texas State Technical College in Sweetwater. This fall, 250 students were enrolled. "It's really not that dangerous," he says, "but for your typical country boy who likes to work outside and with his hands, it's the perfect job."

This year in Nolan County, the wind industry directly employed more than 1300 people. Some, like Bryan Gregory Jr., a third-generation potash miner, answered an ad in the paper and learned skills on the job. "Wind has taken very good care of me and my family," he says. "I started at the bottom and worked my way up." Now Gregory's doing the hiring as a project manager at Bluarc Management Group, a renewable energy asset management firm. "In wind, our guys are cross-functional," he says. "They do everything from IT networking to maintenance to electrical and mechanical troubleshooting to crane work." This year, wind also provided Nolan County with more than 800 construction jobs.

"Up until 2000, the only economic development for 10 or 15 years was prisons," Mayor Wortham told me. Wind power took off after Texas passed a renewable portfolio standard in 1999, mandating that utilities generate 2000 megawatts of renewable energy by 2009. Coupled with a federal renewable-energy-production tax credit, turbines suddenly began to look profitable to wind developers and to communities like Sweetwater. While driving me around, Wortham pointed out Highland High School—both the old part, built in the 1930s, and the new $8 million facility that will soon replace it. Property taxes on wind energy have poured more than $30 million into Nolan County's economy, and in 2005 the population finally stabilized after a decades-long decline.

Roughly 11,000 people live in Sweetwater, where rust-brown pump jacks have long supplemented ranching income. Eight miles due west on Interstate 20 sits the cotton capital of Roscoe. It has about 1300 residents and half as many wind turbines—when the fourth phase of the Roscoe Wind Complex was completed this summer it became the largest wind project in the world. Initially, developers were reluctant to build turbines on farmland because it involved negotiating with so many landowners. So five years ago, retired cotton farmer Cliff Etheredge organized family and friends into one group, under one contract—then paid for his own anemometer tower and took the data to a developer's door.

"This is the first time most of these landowners ever had a chance at a steady income," says Etheredge, who has since started his own business as a wind developer. Because there's not enough rain to recharge groundwater for irrigation, agriculture is touch and go. "Until recently, wind was a tremendous negative because it robbed us of our moisture—the evaporation rate here is many times greater than our rainfall," he says. "Now we're able to sell the wind. And it's a real blessing to us."

The Sunrise Ridge Algae test farm sits deep within the Hornsby Bend Wastewater Treatment Facility in Austin, past mountains of fresh, dark Dillo Dirt—a compost made from treated sewage sludge and yard clippings—and just downslope from a pair of hulking anaerobic digesters. It looks less like a startup company than a squatters' camp. Sheets of black plastic, crisscrossed by PVC pipes and rubber tubing, cover the ground. Sara Norris, the 24-year-old supervising engineer, greets me at the plastic storage shed that serves as the lab. "As I mentioned," she says, "it's very low-tech."

Slim and suntanned, with hair swept back into a long brown ponytail, Norris leads me over to a row of flat, 100-square-meter bags called helioreactors. The algae inside soak up the sun, doubling in number every other day. "You can step on them," Norris tells me as she strides onto their surface in black work boots. "They're really hardy." I follow. It's only after warm water seeps through the permeable fabric and swirls around my exposed feet that I think about what's inside: a mixture of nonpotable wash water and a nitrate- and phosphate-rich fertilizer, processed from sewage sludge. The algae love it; so, apparently, do the flies buzzing around my ankles.

A rancid smell wafts from the direction of the digesters, where bacteria break down the wastewater, forming methane and carbon dioxide. The plant burns the gases off in a stack. "When you combust methane, it produces [even more] carbon dioxide, and we use that to feed our algae and modulate the pH in our bags," Norris says. After

a few days, the algae is harvested and settled in a tank, where it becomes a deep-green pesto-like paste. Then it's dehydrated—for now, in propane dryers rigged from old filing cabinets—and the resulting "algae crackers," which look like sheets of nori, are loaded into a catalytic thermolysis unit off-site. A chemical conversion process turns the algae into crude bio-oil, which can be run through the existing energy infrastructure of refineries and pipelines.

"A really critical part of algae as a viable fuel or energy source is that you're able to get things for free, like nutrients and carbon dioxide," Norris says. Texas produces 676 million metric tons of CO_2 a year, so the opportunities to site algae plants are almost endless. Norris rattles off likely candidates: cement plants, oil refineries, even cattle feedlots. "The stoichiometry," or the math behind the chemistry, "suggests that for every ton of algae you produce you consume one and a half tons of carbon dioxide," she says.

Algae operations can squeeze value from another copious Texas resource: brackish water. The dusty town of Pecos, in the southwestern corner of the state, used to be cotton country—but with only 9 inches of rainfall a year and saline aquifers, the surrounding fields have long since dried up. Today, saltwater algae swirls like pea soup in open raceways behind a Texas AgriLife Research Station run by Texas A&M University. "It's a traditional agronomic society here, but algae's a plant too," Mike Foster, the station's director, says. "If we can show the growers that this is going to work, they'll be the first ones to try it."

Several hurdles—some biological, some technological—still need to be cleared. At Pecos, for example, scientists are looking for an algae species that can withstand temperature swings ranging from blistering to freezing. Researchers at the University of Texas at Austin, meanwhile, are experimenting with more efficient ways to extract oil from algal cells. But the payoff has the potential to be huge: Conservatively, algae can produce between 2500 and 5000 gallons of fuel per acre per year; soy produces 50 and corn, 250. If successful, Texans will effectively leapfrog first-gen biofuels to those poised to turn a profit.

But the state's real strength in the clean-energy economy might lie in its entrenched dirty one. The Energy Independence and Security Act of 2007 mandates that U.S. biofuel production reach 36 billion gallons a year in 2022; only 15 billion gallons can come from corn-based ethanol. But while cellulosic ethanol and algae companies have sprung up from Boston to California, few have made it past the pilot-plant stage of 10,000 or so gallons a year—let alone to the commercial phase of tens of millions. Texas, on the other hand, has more than 26 refineries already processing 7.4 million barrels of petroleum a day.

"The biggest thing people fail to understand about energy is the scale," UT's Webber says. "We understand scale. We have scale of resource and scale of industry. If you want biofuels that satisfy 10 percent of our nation's fuel consumption, which is required with the Energy Independence and Security Act, how are you going to produce and move and blend them? Energy, in the end, is about steel in the ground."

Algae to Biocrude

Sara Norris, a San Antonio native and mechanical engineer, supervises a pilot plant for Sunrise Ridge Algae, which grows algae in flat, white helioreactors containing wastewater. Converting the algae to fuel can help clean up both air and water pollution, she says. "Algae just made sense to me."

In other words, biofuels may have to come through Texas one way or another. And oil companies—hedging their bets against future carbon regulation and declining production—have already begun to nudge open that door. BP, Shell and Chevron have all backed companies working on cellulosic ethanol and algae-based biofuels. This July, even the leviathan Exxon announced a $600 million investment in Synthetic Genomics, a biotechnology company engineering algae to continuously produce oil.

"When you're a small company and just trying things out, you've got to be as cheap as you can be," Sunrise Ridge Algae's CEO, Norman Whitton, says—even spiking helioreactors with Perrier for a quick fix of CO_2 when necessary. "We're trying to pioneer technology," he says, "but we know that in the long run, in order to be even remotely relevant, it's going to take an awful lot of investment."

Last year, the gross domestic product for Texas's oil and gas industry was $200 billion. "We're the headquarters

of the energy industry of today," Texas state representative Mark Strama says. "That should be our biggest competitive advantage at being the headquarters of the energy industry of tomorrow." He adds: "California has Silicon Valley, billionaires who made their money in technology who see renewable energy as the next Internet—and those guys are putting their money where their mouths are. What would totally eclipse all of our competitors is if the fossil fuels industry would say, 'We're going there.'"

With nearly 12 percent of the world's silicon-processing capacity, Texas, as it happens, has a Silicon Valley of its own. Dallas-based Texas Instruments invented the integrated circuit in 1958, and central Texas has since grown into a world leader of semiconductor chip manufacturing. "As a result, you have thousands of people who know how to lay microcircuitry on glass, which is basically how chips are made," Steve Taylor, a senior manager of corporate affairs for Applied Materials, says. "And that's the same concept for solar."

The fastest growing market for chip-based products—cellphones, BlackBerries, laptops and iPods—has moved to Asia, taking semiconductor manufacturers with it. But the talent pool that remains behind in Texas is, in effect, already partially trained to work in a solar factory. "We have a huge market for solar panels, and we have a lot of empty space to put the panels out there," Taylor says. "If Texas takes the initiative, it could be a center for not only solar-panel installation, both rooftop and utility scale, it could also create solar manufacturing jobs here."

Applied Materials makes equipment for manufacturing microchips in Austin and flat-panel displays elsewhere. Three years ago it used that expertise to begin making equipment for thin-film solar panels, which it sells to factories overseas. So far there's only one factory making solar panels in Texas, and it begins production this December. Austin-based HelioVolt uses a thin-film technology too, but with copper indium gallium selenide (CIGS) as the semiconductor instead of silicon. The company coats 2 x 4–foot sheets of glass with CIGS to form circuits, rather than discrete solar cells. These "photovoltaic integrated circuits" can be used for curtain walls, rooftops or ground-mounted solar installations.

Texas has already proven that it can deploy a large-scale renewable—wind. Soon, it will also have the transmission lines to handle power from solar as well. Texas is the only state besides Hawaii and Alaska to have a self-contained electrical grid—regulated by the Electric Reliability Council of Texas, not the Federal Energy Regulatory Commission—and the Public Utility Commission recently approved a $5 billion expansion to the windiest areas of the state. (T. Boone Pickens has delayed his plan to build a wind project in Pampa until these lines reach the panhandle.) Plus, solar could provide power during the day when electrical demand is highest and wind is at its weakest.

According to the National Renewable Energy Laboratory, by developing less than 1 percent of its total land area for solar, Texas could generate enough electricity (without energy storage) to satisfy the state's 2007 demand for more than 300 million megawatt-hours. So far, California leads the country with 528 megawatts of grid-tied solar, followed by New Jersey (70), Colorado (36) and Nevada (34). Less than 5 megawatts of solar power are grid-tied in Texas.

But the state's streamlined regulatory system could vault Texas to lead in solar power too. For example, this summer San Antonio's utility signed a contract with Tessera Solar for a 27-megawatt project in West Texas; the first units are expected to come online by the end of next year. That pace stands in stark contrast to Tessera's experience in California, where the company signed a contract for an 850-megawatt project in 2005 and only recently submitted the 5000-page impact assessment. While the scale of the two projects is vastly different, it is similar to another moment in the two states' history, such as when, in 1999, Texas's 30-megawatt Delaware Mountain Wind Farm began operations on a Culberson County ranch. Texas didn't build small wind projects for long.

The wind boom in Texas has been due, in part, to basic mechanics—turbines are a time-tested technology. Solar, by comparison, is still relatively immature. "The flip side is that the potential for solar to come down in cost is much greater than that of wind," B.J. Stanbery, HelioVolt's chief strategy officer and founder, says. In fact, the price of solar panels has already dropped 40 percent since last year. "So what happens when you have a cost-effective business opportunity in Texas?" Stanbery asks. "Well, we move in and take over."

Next to the northbound lane of I-35 in Austin sprouts unusual landscaping: a row of 16-foot-high "sunflowers" with photovoltaic panels cupped like high-tech petals over welded steel stems. Brewster McCracken takes the next exit and, as we pass a shopping center, points out a green-built Home Depot and a solar-powered Chipotle restaurant. Then, as we drive deeper into Mueller, a 711-acre mixed-use development on the site of Austin's old municipal airport, a control tower rises into view above a horizon of tightly packed homes.

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Though only partially built out, the specs for Mueller, a partnership between the Catellus Development Group and the city of Austin, are already impressive. Mueller includes the world's greenest hospital, more than 75 acres of parkland and 13 miles of bike trails and sidewalks connecting 550 homes—a quarter of which are affordable housing and all of which have been built to Austin Energy's green building standards. The master plan includes native prairie to sequester carbon, a reclaimed water system for irrigation, a town center, a children's museum and housing and employment for 10,000 people.

But McCracken sees an even more ambitious vision playing out here—that of a solar-powered "energy Internet." He is the driving force behind the Pecan Street Project, a nonprofit dedicated to making Austin a laboratory for smart-grid technology. "In the home of the future, you will be able to look at an app on your phone that tells you what your energy usage is, what it's costing you and how it impacts your preset electric budget," McCracken says. "You'll be able to see what individual appliances, whether the refrigerator or air conditioner, are costing you in real time. And you'll be able to control that." Utilities will be able to take advantage of the same software to measure and manage energy flow.

As a demonstration site for the Pecan Street Project (pending federal stimulus funding), Mueller would link 1000 residential meters, 75 commercial meters and plug-in-vehicle-charging stations on a microgrid, testing technologies such as energy storage as well as business models like rooftop solar leasing. "It's technically challenging, but so is the Internet, where you have millions of computers feeding into servers and distributing it out," McCracken says. "The big advantage we have is the extent to which this is now a technology strategy. We're a very entrepreneurial state. And we have some regulatory flexibilities and a business culture that's been really conducive to the high-tech sector."

Besides partners like the University of Texas and the Environmental Defense Fund (EDF), the Pecan Street Project has attracted private companies, including Microsoft, Intel and IBM, that will be able to test their own technologies in a real-world setting—without the approval of the Federal Energy Regulatory Commission. "They see smart-grid deployment as something that is going to go into their markets, so they really want to find out how this all works," John Baker, chief strategy officer for Austin Energy, says.

Austin Energy is municipally owned and vertically integrated—its board is the city council and its customers are its shareholders—so the utility has been able to take the long view on alternative energy: It has led the Pecan Street Project, established the country's first green building standards, distributed smart meters and pushed auto companies to develop plug-in vehicles. State leadership has not been nearly as progressive. The legislature meets for only 140 days every other year. This year, despite bipartisan support, only one of 50 bills with solar incentives passed before the session ended; the legislature meets again in January 2011.

"I think we're a little schizophrenic," James Marston, the director of EDF's Texas office, says. "We know wind worked and we got some jobs, but we're not as aggressive as Colorado or New Mexico or even Michigan [on renewable energy], and we're missing out."

On that point, Sweetwater's Wortham agrees. "That's where Texas thinks we're big dogs," he says. "Texans do things differently. We're independent and sometimes that gets in our way." When a major wind turbine manufacturer considered sites in Texas for a factory, Wortham says, the state let towns sell themselves. "It's like *The Apprentice*," he says. "It slides a little package across the way." Pennsylvania's governor promoted the entire commonwealth as a site and got that factory—which led to others.

Last December, before the 2009 state legislative session began, I had breakfast with McCracken and representative Strama. McCracken was characteristically cerebral but optimistic. Gesturing over a plate of huevos rancheros, he painted a new picture of South Lamar Street, which is the heart of South Austin—"the funky soul of our city." Instead of lube shops, used-car dealers and gas stations—businesses serving the existing energy economy—he described the future of South Lamar under a distributed electrical system, one that will open up the economy to green-collar jobs and lots of small, local entrants.

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>
> ***GREG WORTHAM, MAYOR OF SWEETWATER***

"We can totally screw this up," Strama said, kicking back in his chair from the heavy wooden table. "The energy industry is going to evolve. It can either go the way of the evolution from radio to television, where the existing broadcasters saw change coming, invested in it, and led the change. Or," he said, "it can evolve the way we went from TV to the Internet, where those guys didn't see change coming, and a couple of kids in a garage in California built a company bigger than all of them."

With clean energy poised to become the biggest economic opportunity since the oil boom, that is what's at stake for Texas. **PM**