Manufacturers and researchers are flocking to Albequerque in search of America's PV future

Talk about a solar cluster: New Mexico's largest city and industrial center is fast becoming one. Module, tracking system and rack manufacturers have all gained footholds in Albuquerque. Meanwhile, scientific bodies like Sandia National Laboratories, the University of New Mexico and, now, Fraunhofer's new CFV Solar Test Laboratory, are putting the city on the US solar energy map in a big way.

An employee at Zomeworks, headquartered in Albuquerque, makes metal fittings for the company's passive trackers.

n a vast, wide-open plain overlooking Albuquerque called Mesa del Sol, Michael Jacquorie, COO of Schott Solar AG, describes the company's full manufacturing process at its 1-year-old facility, where 225 W, 230 W and 235 W multicrystalline photovoltaic (PV) modules are being churned out 24 hours a day, 7 days a week, for sale on the US market.

He points to where the glass sheets are prepared and the matrix is »baked« in an oven laminator; where speedy robots apply an embedded protective foil; and where the flasher-process testing for positive and negative tolerance occurs, just before the modules get checked for their electrical performance, then stacked and prepared for shipment. The soldering process here is fully automated, cell by cell, says Jacquorie.

So why, exactly, did a German solar titan like Schott build its \$140 million flagship US plant - a unique hybrid, which combines concentrating solar power (CSP) production facilities of 400 MW annual capacity with a PV module plant of 100 MW capacity - right here in Albuquerque, a city of less than 1 million people?

»First, to be right in the middle of where the main US market is going to be - the Southwest,« Jacquorie says, adding, »Second, the support we received from the New Mexican government and Albuquerque's administration, and the financial incentives they offered; third, a well-qualified labor force and good infrastructure in terms of laboratories and facilities.«

And now that it is here, Schott, which employs 150 people at its plant, is helping the nonprofit Albuquerque Economic Development Group and the city's Chamber of Commerce lure other



solar companies to the city as well. »It's a win-win, «Jacquorie says. »If more solar industry comes here, it can only be to our advantage.«

Racking and tracking

Schott's ambitious production line reflects a growing confidence that Albuquerque will soon become, and in notable ways, already is, one of the principle PV hubs in the country – a place capable of drawing solar manufacturers,

Unirac, based in Albuquerque, has doubled its business for 2 consecutive years.

researchers and investors alike. Part of the reason is New Mexico's Alternative Energy Manufacturers Tax Credit, which offers a 6-percent credit for renewable energy businesses that set up shop in the state. Other factors include the relatively low cost of living, the great solar resource and the central location between Texas and Western states' markets. Indeed, some firms here are already boasting real numbers.

Take, for example, America's premier PV racking system maker, Unirac Inc., headquartered in Albuquerque, which doubled business in both 2009 and 2010 after seeing 80-percent growth in 2008. The company currently employs 126 people and sold racking that was used in some 270 MW of installations across the US last year. About three-quarters of those projects were commercial- and utility-scale. Unirac claims to hold 40 percent of that market; whereas the company says it commands 26 percent of the market for residential racking systems.

Purchased in 2010 by the Lichtenstein-based tools manufacturer Hilti Group, Unirac has leaned notably toward commercial-scale production since launching its steel ISYS Ground Mount and Roof Mount systems – for projects larger than 500 kW and 300 kW, respectively – in 2009. To date, Unirac says it has supplied racking for 18 projects in the US of 1 MW or greater, a figure that



Professor Andrea Mammoli heads the solar research team at UNM's School of Engineering.

»wouldn't have been believable only a couple of years ago,« because the company didn't have any projects that size, says Marketing Director Marcelo Gomez.

Indeed, the company's 7,500 m² factory space in downtown Albuquerque has become a powerhouse for both production and innovation. Last year alone, 2.5 million kg of aluminum racking for residential systems were manufactured here. Accessibility to the product has helped make Unirac a leader in its field. For example, the company's mobile platform website allows installers to dispense with paper instructions and fol-





low all installation procedures on their smart phones. And as the current racking design goes, it »eliminates the use of any field welding, field cutting and field drilling, which saves a lot on labor,« says Gomez, adding, » We call it, ›Assemble, don't build.««

But just as Unirac is not this city's sole racking manufacturer - DPW Solar, which makes the Power-Fab racking system, is also based here -competition in Albuquerque extends into the realm of tracking system designers as well. With claims to be the oldest electric tracker manufacturer in the world, Array Technologies Inc., founded by Ron Corio in 1989 under the name Wattsun Corp., has shifted its focus dramatically in the last 5 years from off-grid residential systems to utility-scale projects. With the Duratrack HZ model leading the way, Corio says, Array has installed 120 MW of trackers worldwide, and its Albuquerque manufacturing facility is currently operating at 480 MW of annual capacity. The city's lower operating costs and its geography make it »a great location for solar companies.«

Schott Solar employees prepare finished modules for packaging and shipment at the company's 1-year-old production line in Albuquerque.

Also in Albuquerque is another veteran tracking manufacturer, Zomeworks Corp., founded in 1969, which makes passive trackers for residential systems employing Freon gas that creates pressure, tilting the tracker toward the sun as it heats up throughout the day. Employing just 20 workers, Zomeworks pushed 540 of its trackers out the door in 2010. The company has a total of more than 17,000 products in the field. (Zomeworks was especially busy last year manufacturing several hundred trackers for shipment to US military operations in Iraq.)

Ideal for off-grid purposes such as powering water pumps on remote ranches in the Southwest, the Zomeworks UTR 20 (with close to 2 m² of module space) retails for \$712, while the UTR 168 (with 15.6 m² of module space) sells for \$3,636 and can hold anywhere from 1.8 to 2.5 kW of modules. However, Zomeworks trackers are not recommended for extremely cold environments. According to spokesman Patrick Lewis, temperatures of -30 °C and under in places like Canada during the winter can stiffen the shock absorbers and inhibit the tracker's movement.

A nexus of specialists

As it grows as a PV manufacturing center, Albuquerque is also welcoming more researchers into its midst. At the School of Engineering at the University of New Mexico (UNM), for example, a team led by Professor Andrea Mammoli is studying battery storage capacities and looking at ways to reduce electrical load so as to decrease the risk of voltage spikes when a PV system's production drops suddenly due to cloud shading or other environmental variables. With a 75 kW array of Schott modules mounted on a campus rooftop, the team is building a \$2 million, 500 kW system on Mesa del Sol-funded by the US Department of En-



ergy (DOE), in collaboration with utility PNM and Sandia National Laboratories – to experiment with battery storage. The aim is to find ways to efficiently store and move electricity from peak production periods to peak load times.

Sandia is the larger institution in Albuquerque dedicated to PV research, whose \$12 million Department of Defense (DOD) funded Photovoltaic Systems Evaluation Laboratory (PSEL) conducts research into both the variability and reliability of solar modules. One of the lab's specific aims, says solar technology expert Michael Quintana, is to understand how power surges affect inverters, while other areas of focus include measuring the impact of weather on PV systems in hot and cold climates, detecting how degradation to a system occurs and measuring power losses due to environmental stresses.

Now, a newer player has also joined the city's solar research mix – the CFV Solar Test Laboratory. The lab is a joint venture started by four nonprofit groups: the Fraunhofer Center for Sustainable Energy Systems (FCSES), in Cambridge, Massachusetts; the Fraunhofer Institute for Solar Energy Systems (ISE) in Freiburg, Germany; the Canadian Standards Association (CSA); and the VDE Institute, based in Frankfurt am Main, Germany. It will be a testing center for US-made modules that conforms to both UL and IEC certification standards, paving the way for the speedier, qualified entry of those devices into the European and US markets.

With plans to start processing modules at its new 2,000 m² facility in Mesa del Sol in April, the test lab will employ 11 people at the start, with plans to double that figure in the next year or so.

»It was clear from the beginning that the Southwest is where most of the PV in the US will be installed, and we wanted to be part of the cluster of solar activities,« says CFV President Christian Hoepfner. The reasons for establishing the test center in Albuquerque, he says, were many: to be close to Sandia and UNM, as well as the National Renewable Energy Laboratory (NREL) in Colorado; to make use of the state's high solar irradiance levels; and to take advantage of a good business climate and »a highly skilled workforce with lots of experience in solar testing and solar technologies.« Hoepfner adds, »Albuquerque was just the logical choice.«

One of the main goals of the CFV lab is to shorten the lead time for certification, so that module makers aren't forced to wait as long to start marketing their products. »The time to market is very much influenced by the time it takes nies seeking »precertification« testing of their modules before they prepare them for manufacturing. Each test will last 2 to 3 months on average, and everything from crystalline PV to thin films, concentrating PV (CPV) and building-integrated PV (BIPV) will be studied. Mostly, Plass says, »the certification is to prevent infant mortalities – to make sure these [products] don't die 6 months or 1 year into the field.«

At its core, however, CFV is an attempt by Fraunhofer – a Germany-based research institute that employs 17,000



[manufacturers] to get their products tested and certified, both for new products and for retesting,« says CFV senior vice president Martin Plass, who adds, »A lot of laboratories took their sweet time in the past to do that, or were so full that they just couldn't process it any quicker, and it really impacted manufacturers.«

The lab guarantees a minimum capacity of 80 full certifications annually and sees itself attracting three main clients: European module makers like Schott, which are seeking to sell their products in the US market; North American manufacturers looking for UL certification to sell their products in the US; and compapeople worldwide – to »keep our hand on the pulse of the industry,« according to Hoepfner.

»This is where new products will first hit the market – this is where you will see what works [and] what doesn't work,« he says, adding, »I don't think there will be only one hub in the US, but the greater Albuquerque area certainly has all the ingredients to become very successful in this industry. The state government, the county, the city of Albuquerque have supported solar in many different ways. The state of New Mexico gets it: it knows how important this industry will be.«

Michael Levitin



NEW MEXICO

New Mexico

REACHING FOR THE New Mexico is ramping up its PV industry. New Mexico is ramping up its PV industry. With 120 MW to be installed over the next year

The other Sunshine State: When it comes to generating solar power, few states are better situated than New Mexico, which receives more than 300 days of sunshine per year at irradiance levels second only to those of Arizona within the US.

New Mexico has the second-highest solar irradiance levels in the country and a cool, high-elevation climate that is ideal for maximizing PV output. It also benefits from renewable energy credits and tax breaks for PV homeowners, businesses and manufacturers. With four large megawatt-sized projects slated to come on line by the end of the year, the state will more than quadruple its 2010 installed PV capacity. Not only that, but New Mexico is laying the groundwork to become a big renewable energy exporter as well.

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SUMMIT

Mountains, the University of New Mexico (UNM) campus at Taos has some bright news to report: it claims to be the only university in the US whose energy needs are met exclusively with solar power. The 500 kW photovoltaic (PV) array installed there in 2009 by Taos-based PPC Solar (formerly Paradise Power Company Inc.) generates double the daily 200 kWh of electricity that the campus needs to

erched out on a hard, dry slope of

tumbleweed and scrub desert at the

southern tip of the Sangre de Cristo

operate, thus ensuring long-term offsets and added income for the local utility that commissioned it.

Kit Carson Electric Cooperative Inc. (KCEC), which supplies power to about 40,000 people in Taos, Colfax and Rio

Riba counties, financed this installation along with four other regional PV projects using \$5 million in federal clean renewable energy bonds (CREBs), to be paid off at 0.4-percent interest over 15 years. »We've gone from talking about [solar] to really deploying it, implementing it and now testing it in the community,« says KCEC CEO Luis Reyes, adding, »At least in this area, solar is not the exception; it's the rule.«

Reyes' optimism is backed by solid numbers and is a symbol of the speed at which New Mexico is jumping into the solar power generation market. In the past year, his utility connected a 43 kW carport array at radio station KTAO, as well as a \$400,000, 100 kW carport array at KCEC company headquarters. In the first quarter of 2011, another 250 kW array at a

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of impurities in the air are said to improve module efficiencies. charter school in Taos and a 100 kW system at a soccer training facility here are scheduled for connection. In addition, KCEC announced it commissioned a 1.5

MW concentrating PV (CPV) project in Amalia, 80 km to the north, and signed a 20-year power purchase agreement (PPA) with Chevron Venture Technologies LLC for the 1.2 MW CPV system it recently completed in nearby Questa.

For KCEC's raft of PV projects, the utility is earning 14c per kWh in renewable energy credits (RECs) paid by the Denver, Colorado-based power supplier Tri-State Generation and Transmission Association Inc. Because of these REC

payments, Reyes says that he's not only able to keep the cost to each of his ratepayers down to an additional 10¢ monthly charge, but KCEC will also be able to pay off the \$5 million in CREBs in only 7 or 8 years – half the allotted time.

Taken together, the Taos installations represent only a fraction of the 120 MW of solar projects scheduled to come on line in New Mexico over the next year and a half, which will more than quadruple the state's 2010 PV capacity of 38 MW. But in a sense, the projects in Taos are symbolic of the progress that is being made here. Solar manufacturing and research have excelled in the state (see article, p. 94). And with the second-highest solar irradiance levels in the nation after Arizona and a population of just 2 million, New Mexico is now planning to build a heavy-duty network of transmission lines to export PV-generated power out of state. According to Craig O'Hare, the former special assistant for clean energy at New Mexico's Energy, Minerals and Natural Resources Department (EMNRD), "The state easily has 10,000 MW of solar energy potential." The question is: with coal, oil and natural gas all prevalent industries here, how best to go about tapping it?

Ratcheting up the incentives

Under former Governor Bill Richardson, New Mexico scored a modest but still sizeable sum of victories to help lay a foundation for future solar growth. In 2004, the state adopted a Renewable Portfolio Standard (RPS) requiring utilities to generate 5 percent of the energy that they distribute from renewable sources by 2006 and 10 percent by 2011. The most immediate impact of this legislation was the installation of several hundred megawatts of wind power. Two years later, in 2006, the Public Regulatory Commission (PRC) began enforcing payment of RECs by the state's three large investor-owned utilities (IOUs) to the tune of 12¢ on average for every generated kilowatt-hour of solar power. The state Assembly also passed a 6-percent Alternative Energy Product Manufacturers Tax Credit to lure new solar manufacturing to the state.

Then in 2007, the 10 kW net-metering cap for PV generation was raised to 80 MW, and the RPS for private utilities was extended to 15 percent by 2015 and 20 percent by 2020. (For co-ops and municipal utilities, only 5 percent by 2015 and 10 percent by 2020 are required). Of additional importance that year, under Commissioner Jason Marks, the PRC won a ruling to create a solar carve-out, which stipulated that PV account for 20 percent of the RPS, as well as 1.5 percent of distributed generation by 2011 and 3 percent by 2015.

»1,100 jobs in a small state like New Mexico isn't chicken feed.«

Craig O'Hare, former special assistant for clean energy at the New Mexico EMNRD.

Until that point, recalls O'Hare, solar in New Mexico stood at a disadvantage because »it was all about finding the least expensive renewable resource for the utilities to keep the cost as low as possible, and that resource was wind.« With the solar carve-out, the state announced clearly, »We've got a great solar resource, and we want to develop it,« O'Hare says, adding, »It saw the RPS as a tool to stimulate the state's solar-based economy.« Marks concurs: »What's driving solar in the state are the REC payments and the carve-out.«

As a result, New Mexico hasn't just seen a lift-off in residential and commercial PV jobs, but a flurry of utility-scale activity as well. In January, the Southern Company utility and Ted Turner announced the completion of the 30 MW Cimarron Solar Facility in Colfax County, built by First Solar. Cimarron has been supplying power to the Tri-State Generation and Transmission Association since December 2010. Other big projects currently underway include: five 10 MW solar farms contracted jointly by



the Southwestern Public Service and Sun Edison utilities in the southeastern part of the state; a 20 MW project shared by El Paso Electric and the nuclear power company NRG Energy, near Las Cruces; and 22 MW of distributed generation spread across five regions, to be managed by the Public Service Company of New Mexico (PNM), the state's largest utility. All of these projects are scheduled to come on line either in late 2011 or in the early months of 2012.

Finally, in 2009, the state Legislature passed a property-assessed clean energy (PACE) financing bill known as the Renewable Energy Financing District Act (see interview, p. 90), which provides loans for commercial as well as residential installations. The Legislature also approved a 6-percent Advanced Energy Tax Credit for commercial installations of 1 MW or greater.

Now that PV manufacturing and installations are starting to take off in the state, New Mexico faces a new concern. »Because we're only 2 million people, our in-state demand and appetite for

Craig O'Hare, former special assistant for clean energy at the New Mexico EMNRD, says a 20-percent solar carve-out was key for PV investment. Investment Management building, just north of Santa Fe, in December. renewable energy is only so great,« says O'Hare. He claims that New Mexico's

PPC Solar completed this 197 kW

installation on the new Thornburg

O'Hare. He claims that New Mexico's energy generation potential from solar, wind and geothermal is greater than 25 GW, compared to around 4 to 5 GW of demand for renewables. Which is why, with electricity-thirsty states located to the north, east and west, an agency has been created to engineer the future mass export of solar and other clean forms of power.

Selling PV energy out of state

Since its founding in 2007, the quasistate body known as the New Mexico Renewable Energy Transmission Authority (RETA) has been working to design and facilitate the export of utility-scale renewable energy out of state. While New Mexico is one of eight US states to establish a transmission authority – nearly all of them are located in the West – it is the first of its kind to have a renewables requirement: specifically, that 30 percent of the power the state exports must be generated from renewable sources.

Based on a transmission map study that was commissioned by Los Alamos National Laboratory (LANL) and released in October 2010, RETA is looking closely at two main energy-exporting options of

(EM)POWERING THE RESERVATIONS



Dressed in blue jeans with black leather boots, a burgundy shirt, turquoise ring and bolo tie, Odes Armijo-Caster looks every bit the rugged New Mexican businessman. It's a good thing, too, since many of his work hours are spent installing photovoltaics (PV) out on his state's most rugged terrain: the reservations.

Sacred Power Corp., the manufacturing company that Odes cofounded in Albuquerque in 2001, has installed more than 400 stand-alone PV systems across New Mexico's impoverished Navajo lands and other Native American reservations. Thousands of families living in these areas still lack access to any type of electricity. More than twothirds of the 60 employees working at Odes' firm are Native American. With 30-percent annual growth and a reported \$10 million in product turnover last year, something about the business model seems to be working.

»Part of our business is about changing lives; people who didn't have electricity now have it,« Odes said recently while steering his Lincoln pickup 80 km west of Albuquerque across the rocky desert to a village called Paguate, on the Paguate is one of hundreds of Native American towns that have benefited from Sacred Power's stand-alone PV systems.

Laguna Indian Reservation, hauling one of his patented SP Hybrid solar systems on the trailer behind it. »I live and die by solar,« he added. »It's what I do.«

Since it is hard to transport and install PV system parts on what are oftentimes shoddy roofs on isolated reservations, Odes came up with the idea of building entire prepackaged systems in a 4,400 m² factory in Albuquerque and delivering them ready-made.

Odes calls his product a »drag-anddrop, plug-and-play« system. In terms of its components, the SP Hybrid he delivered to the Laguna tribe that day consisted of an 850 W array of Photowatt modules fixed on a Unirac tracker. The tracker was mounted on a steel skid that also contained a builtin, gas-powered Centurion backup generator, a 2.5 kW Outback inverter, a Phocos charge regulator, a controller and a pair of batteries inside a powdercoated galvanized steel box designed to withstand corrosion. »All we have to do when we get out there is plug it



Odes Armijo-Caster helps unload and put in place one of his »drag-and-drop« SP Hybrids on the Laguna Indian Reservation. The system will provide electricity for the new visitor center, helping to generate income for the town.



The company has produced some 650 SP Hybrids at its manufacturing facility in Albuquerque.

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in,« he said, and the system will be charging.

At a cost of about \$16,000 each (which amounts to \$18.80 per W), the SP Hybrid is by no means cheap. But thanks to Rural Utilities Service grants from the US Department of Agriculture, Sacred Power has sold more than 650 of these self-contained PV systems of 1 kW or under to date. You can find SP Hybrids charging remote hurricanedetection systems in the Caribbean for the US Geological Survey and supplying power to desert bases for US military operations in Afghanistan and Iraq.

In the future, said Odes, »we'd love to get into the disaster preparedness market; the systems would be ideal for Haiti and other emergency situations and disaster areas, where you could just drop them into camps.«

For now, though, it's Native American townships like Paguate where Sacred Power is continuing to have the most impact. At the bottom of a winding lane known as Pork Chop Hill Road, Odes stops his truck beside a small lake and two young Laguna employees slide the SP Hybrid system off the trailer and into place next to a small building, which is to serve as a new visitor center for tourists coming to fish.

According to the White House, as reported in the New York Times, more than 14 percent of homes on Native American reservations are lacking power. The challenge motivating Odes, who is Hispanic by birth, is »to build a solar industry for the Native Americans, to teach them about renewable technology and help them develop their infrastructure.

»For generations, these communities haven't had power,« he said, adding, »Now, instead of reading by kerosene, they have electricity; the solar systems have been a real blessing for them.« *mal* the future. The first involves an upgrade to the existing transmission lines (ranging from 115 to 230 kV) throughout New Mexico, at a cost of about \$1.1 billion. The second plan – which is pricier, at \$1.3 billion – entails looping the state in brand-new higher efficiency 345 kV lines.

Whereas LANL recommends the first option, RETA's executive director, Jeremy Turner, says his agency is favoring the second, costlier plan because it would make New Mexico capable of exporting greater amounts of power more reliably, with less redundancy and line loss. »New Mexico has tremendous opportunities from the solar perspective,« says Turner, adding, »What we're trying to do is figure out a long-range vision, a 20-year plan, to export renewable power out of state, which is not contingent on regional projects but is enhanced by those projects.«

While the decision on the transmission network has not yet been reached, in November, RETA issued an initial set of bonds worth \$50 million to upgrade an 84 km-long utility line to be used for a 100 MW wind farm. Turner says that with other upgrades like that, and eventually with a new set of transmission lines altogether, New Mexico can create a »liquid trading hub« of clean energy at the Four Corners region, bordering Arizona, Utah and Colorado, where power





Cindy Bothwell, PNM's manager of integrated resource planning, questions whether average ratepayers should be subsidizing those who invest in solar.

will get shipped to markets as diverse as Texas and California.

»This is not a competing industry to oil and gas and more mature markets,« Turner notes, adding, »It's actually a complimentary industry, which, if done correctly, can create an economic base, create jobs in the state and provide us with an opportunity to help New Mexico economically, while getting clean power exported out of the state.«

The right conditions, despite barriers

Indeed, when it comes to generating solar power, few states are better situated than New Mexico, which receives more than 300 days of sunshine per year. Moreover, the state's high irradiance levels, coupled with cooler temperatures due to an average altitude of 1,700 m, mean higher module efficiencies. The clearer mountain air also contains fewer impurities, which translates into a better absorption of sunlight. As physical conditions go, New Mexico appears to have all the right factors.

But just what all of this means in terms of real job potential and the state's

Mike Reynolds, founder and owner of Earthship Biotecture, inside the new Phoenix Earthship structure.



future solar economy remains less certain. After all, New Mexico is still relatively rich in coal, oil and natural gas reserves, not to mention uranium supplies. As part of its transmission map study, LANL calculated that some 1,100 jobs would be created annually over 20 years with the development of 5.2 GW of transmission-line capacity. And as officials like O'Hare are quick to acknowledge, »there's a recognition that renewable energy development is primarily about economic development and job creation - and 1,100 jobs in a small state like New Mexico isn't chicken feed.«

That said, the conflicted role that the utility giant PNM is playing with respect to PV grid integration provides a glimpse at the barriers that solar still faces. The utility, which services 60 percent of New Mexicans with its installed capacity of around 2.6 GW has already asserted leadership in the area of wind; its 200 MW wind capacity represents one-third of the state's total. Now, PNM is stepping into the solar market with two projects: 24 MW in small- to mid-sized distributed generation ranging from 2 to 1,000 kW systems, and 22 MW in utility-scale installations spread over five sites. This is

in addition to a 500 kW battery storage experiment.

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The utility generates around 66 percent of its power from coal, 19 percent from nuclear, 9 percent from natural gas and 6 percent from renewables. Solar contributes less than 1 percent of that amount, due to PNM's fear that it might »do too much too soon, because we carry that cost along with us for the life of the project,« says Cindy Bothwell, the company's manager of integrated resource planning.

In addition, she maintains there is a sense of unfairness among PNM's ratepayers, all of whom assume the costs of solar even though only a few actually benefit from owning the systems.

»We're concerned about the ratepayers,« Bothwell says, adding, »If you're not a PV owner, you're basically subsidizing your neighbor who is, because [the system owners] aren't paying a bill to PNM – they're getting a check back.«

What's more, Bothwell argues that there is an imbalance due to the fact that system owners benefit from the grid even when their own arrays are not producing. »At nighttime, or on a cloudy day, their panels aren't generating but they're still using all of the infrastructure: the transmission system, the distribution system, the meters, the transformers yet they're not paying PNM,« she notes, adding, »When it's just a few systems, that's easy to manage, but if all of our customers had solar panels, and all of them were net metered, and nobody paid a bill, yet they used the entire system that's not right.«

Installers: The big, the small, the costly

Not everyone, though, is feeling doubts about how quickly New Mexico should move forward with solar – least of all, its installers. In the desert hills north of Santa Fe, overlooking the tan, square-shaped adobe-style homes of the Las Estrellas housing development, Daniel Weinman, president and CEO of PPC Solar, surveyed the 197 kW gridtied array he had just finished install-

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STATE SENATOR PETER WIRTH HELPED PUSH THROUGH NEW MEXICO'S UNQUE

In 2004, after working for 20 years as a lawyer, Peter Wirth won election to the New Mexico state Senate. In 2009 he was instrumental to the passage of Senate Bill 647, a propertyassessed clean energy (PACE) financing bill, which was also known as the Renewable Energy Financing District Act. In a conversation with PHOTON, Wirth discussed what makes New Mexico's PACE program unique, how the state can reconcile its competing energy interests, and why he thinks electricity bills are a thing of the past.

PHOTON What would you say are New Mexico's biggest solar legislative achievements to date?

Sen. Peter Wirth In 2004, we put in place a Renewable Energy Standard [RES] that has us reaching 20-percent renewable energy with investor-owned utilities by

2020, which sent a huge signal that our utilities had to start making the transition. But one of the bills I'm most excited about is the Renewable Energy Financing District [Act], which allows local governments to create a district of homeowners and issue bonds to pay for new photovoltaics [PV], wind or other renewable energy systems, with up to 100-percent financing on your property tax assessment to be paid off over 20 years. All of the PV installers were ready to go, and I think there would have been a huge demand, but the Federal Housing Finance Agency [FHFA] stepped in and shut the program down.

PHOTON Is there something that makes your PACE program different from those of other states?



State Senator Peter Wirth has been an ardent solar advocate during his 6 years in office.

Wirth One of key things we did was we made the legislation as broad as possible, to include wind, biomass, etc. But what's different about our program is that it's not just residential but commercial as well, which allows local governments to come in and experiment with it. If Santa Fe County proceeds with its commercial PACE program, it will be the first in the country.

PHOTON In other words, if a business here wants to spend a half million dollars getting re-outfitted with PV, it can get a 20-year loan too?

Wirth Yes, and it'll be able to use that on its property tax assessment. What's interesting is that the bill allows businesses to make the investment, and then if within 2 years, let's say, business goes bad and the decision is made to sell the property, the new owner buying the property takes over the assessment. This an underlying piece of the PACE programs - that the financing runs with the land. It's very different from a typical loan, which has to get paid off if you sell your property. **PHOTON** What sort of incentives would a typical homeowner who chooses to install solar in the state receive? Wirth We have the 30-percent federal credit and an additional 10-percent credit at the state level, meaning you get back 40 percent of the value of that system in tax credits the first year. There's 100-percent loan financing through the PACE program, and then you've got your renewable energy credits [RECs]. For example, we just

put in a 3.4 kW solar tracker at our house, so in addition to the 40-percent tax credit,

[regional utility] PNM is paying us 8¢ per kWh to net meter and an additional 13¢ per kWh in RECs. That's 21¢ for every kilowatt-hour that I generate.

PHOTON Does that mean you're no longer paying anything for your electricity?

Wirth Nothing. I now get a check in the mail every month from PNM that ranges from \$60 to \$110. And the thing about PACE [when it returns] is that it's not a mandate on anybody; each homeowner gets the chance to make the decision, which is one of the reasons the bill became sellable in the Legislature. With PACE, we're talking about stimulus: cash on the table, financed out over a period of time, and it's something that any family sitting around the dining room table

PACE LEGISLATION

looking at their finances needs to give a serious look [at]. We've reached a point in New Mexico, with the tax credits plus the RECs plus the net metering, where all of a sudden this begins to make a lot of economic sense.

PHOTON Legislation aside, what's going to drive PV development from a market standpoint?

Wirth Over the last 8 years, we had a boom in oil and gas unlike anything this state has ever seen. In 2007 and 2008, the price of natural gas was up to \$10 per 1,000 ft³, with every 10¢ price change representing about \$12 million for the state of New Mexico. Now natural gas is at \$4 – a bigger decline than at any time in the state's history – so you can see the driver right there. [With fossil fuels,] we're on this wild roller coaster.

PHOTON What about setbacks – policies that you have not been able to accomplish in the Senate?

Wirth There were a number of attempts to get a greenhouse gas inventory through the Legislature and we couldn't, but [former] Governor [Bill] Richardson used the tools of the executive and pushed it forward. Cap and trade is another example: they tried to run a bill through the Legislature and it didn't pass, so they went through the Environmental Improvement Board instead. There's going to be a big discussion about cap and trade because the new governor, Susana Martinez, has said it's one of the first things she is going to do away with.

PHOTON Do you fear that Governor Martinez will drastically cut the budget for renewables?

Wirth It would be a huge mistake to take a step backward. In a poor state like this we need economic development drivers and I think being at the forefront of this transition to renewable energy will result in jobs, which is what we desperately need. Governor Martinez was elected with huge support from oil and gas, so this is the tension you're seeing – between the old economy and the new, between traditional energy and renewables. We are an energy-producing state. We have large natural gas reserves, and we have oil and coal. So we have to figure out how to sit down together and not have this be about oil versus renewables.

PHOTON What kind of pushback have you seen from industry and big utilities?

Wirth Well, we didn't get a pushback from the mortgage lenders because they simply didn't participate in the discussion. There was almost a disbelief that you could put a system like PACE in place with an assessment that runs with the land. As for PNM, they're a private utility. They've got shareholders; they've got a bottom line. So when the government comes in and says, »We're changing the status quo,« there's always going to be pushback. My approach has been to work together to help them be part of the change versus trying to jam it [through the Legislature] and constantly having a fight on your hands, which you may lose.

PHOTON The state seems to be moving quickly ahead with more larger commercial-scale projects than smaller distributed-generation systems.

Wirth I think what's exciting about New Mexico is that we've got the platform to do both, and we've laid the groundwork for both. We had a governor in Bill Richardson who was an absolute leader in terms of pushing the state forward with renewable energy and making it an economic development tool for this state. There's a realization now that you can discuss the energy transition – that we're moving in a direction that is incredibly positive.

PHOTON Thank you for the interview. Interview: Michael Levitin ing in December on the rooftop of the headquarters of Thornburg Investment Management – the biggest LEED-Goldcertified building in the state. Designed and engineered by the integrator American Capital Energy Inc., the project cost \$1 million, or about \$5 per W (with 30 percent returned in federal tax credits, 10 percent in state tax credits and REC payments from PNM of 15c per kWh). Intended to cover 20 to 30 percent of the building's energy needs, the system has an expected payoff time of 5 years, after which it will generate \$60,000 in annual savings.

»When we started the business, there weren't a lot of companies in the state doing this,« says Weinman, a strapping man who wears a white hard hat and has raccoon eyes from all the hours he's spent in the sun. Once an installer of smallscale systems, he now takes on increasingly large jobs – like the 1.2 MW array he was contracted to install the following month at Santa Fe's water treatment plant, powering pumps to bring 55,000 liters a day from the nearby Rio Grande River. »Now we've been growing as the industry is booming, and we found our niche,« Weinman notes, adding, »Three years ago we had four people; today we're overextended, buried in work.«

Adi Pieper, of Adi Solar Electric, is another installer with a steady flow of



Luis Reyes, CEO of KCEC.





There are 65 off-grid, solar-powered Earthships on the plain beneath Taos Mountain.

business in and around Santa Fe, though he is on the other end of the spectrum. Originally from Berlin, Germany, Pieper came here 2 decades ago and started a solar business that provides mainly small residential systems of 3 to 4 kW, and never larger than 10 kW. Pieper says an average grid-tied array costs him around \$5 per W to install, although »that's pushing it now, with a fairly slim profit margin, and the competition is fierce.«



In December, Pieper - a long-faced, cowboy-attired man who teaches in the renewable energy program at Santa Fe Community College and has published the two-volume »Easy Guide to Solar Electric« – installed a 4.2 kW grid-tied, battery-backup hybrid system in the pine-studded desert bedroom community of El Dorado, 16 km north of Santa Fe. Its owner, David Coulson, currently receives 12¢ per kWh in RECs from PNM and another 8¢ per kWh for the net-metered energy he feeds back into the grid. »Economically it represents a return on investment right away,« says Coulson, adding, »It's roughly 10 percent - slightly better than a savings account.«

Whereas Adi Solar Electric employs only three to four workers, a third New Mexico installer, Positive Energy Inc., works on similar small-sized projects around the state but has 40 employees. Based in Santa Fe, with offices in Albuquerque, Las Cruces and Taos, the company exceeded 1 MW in total installations in 2010 – with most of the jobs coming in at 5 kW and under.

Daniel Weinman, president and CEO of PPC Solar.

Built in the 1880s, St. Francis Cathedral Basilica is a Santa Fe landmark.

In Taos, for example, Positive Energy had just finished installing a 1.8 kW grid-tied system in December at the home of Kerry and Mi-lai Huebeck. Composed of eight SunPower 215 W modules mounted on a DPW tilt-adjustment pole rack, with a 3 kW SMA inverter, the system will supply 80 percent of the home's electricity consumption. Karlis Viceps, the company's Taos representative, says that as a rural installer, Positive Energy must sometimes offer bids above its competitors. And because it rarely uses modules made in China, preferring instead the higher efficiency but more costly Sun-Power panels, its installation prices can reach as high as \$7.50 or \$8 per W - well beyond those of a firm like Adi Solar Electric

»When you're in a rural location, everything costs more, « says Viceps, who served as president of the New Mexico Solar Energy Association (NMSEA) in the 1990s and currently teaches solar technology at the UNM campus at Taos. »As the largest community in a 70 to 80 mile [110 to 130 km] region, we tend to deal a lot with [higher pricing], « he notes.





PV for survivalists

Not that all New Mexicans have costper-watt savings – or even, for that matter, connection to the grid – on their minds. On the contrary, in the Earthship Biotecture community of organic, off-grid, solarized homes that have been continuously developed by the architect Mike Reynolds since the 1970s, PV is more than an energy saver. It's a way of life. During a bright December day, PHO-TON journeyed out to visit the newly completed Phoenix Earthship, one of 65 structures made out of earth and recycled materials on a 2.6 km² rocky desert terrain overlooking the Rio Grande Gorge, at the base of Taos Mountain. Supplied with eight Kyocera 200 W modules on the rooftop and six 200 W modules on the ground, the 2.8 kW, \$30,000 array combines rainwater catchment, biodiesel and an organic heating and cooling sys-



tem to present what Reynolds calls a selfsustaining »survival building,« replete with modern amenities such as flush toilettes, a propane-powered refrigerator, satellite TV and high-speed internet.

Long before the legislation and financing tools for solar energy emerged during the last decade in New Mexico, Reynolds and his community of PVenthusiasts were here – homesteading inside walls made out of mud and soda bottles and car tires, and using no more energy than what they generated from the sun. And here, regardless of the state's manufacturing, export and subsidy of solar power, or lack thereof, they will in all likelihood remain.

»The sun provides us. The biology provides us. The physics provides us,« says Reynolds, who was once the subject of a film called »Garbage Warrior.« »Here, people aren't paranoid waiting for a corporation to shut off their electricity because they can't pay the bill,« he notes, adding, »If you did this all over the world, what do we have to fight about?« Michael Levitin

Mi-Lai Huebeck, next to her 1.8 kW SunPower array, installed in December by Positive Energy.