

Blending Solar and Architecture, Chicago Style *BIPV to be Displayed Within a Widely Anticipated Chicago Tourist Attraction*

By Gabriela Martin

One of the nation's largest electric utilities is supporting solar energy in the next millennium. Millennium Park, that is. Chicago's electric utility, Commonwealth Edison (ComEd), and parent company Exelon Corporation are making a \$3 million joint donation for solar electric technology in Chicago's Millennium Park, which is expected to be one of the world's most stunning public spaces. This effort aims to promote and showcase renewable energy and helps bring Chicago closer to becoming the country's "green capital."

Currently in the design phase, the project will create two pavilions positioned on either side

of the park's indoor Chicago Music and Dance Theater. Construction will begin this fall and should be completed in June 2004. Each 6,000-square-foot pavilion will utilize a 37.5-kilowatt building-integrated photovoltaic system (BIPV). According to Edward Uhler, Millennium Park project design director, the decision to use BIPV was not only an architectural plus but also a practical solution over using a traditional solar array.

"Since this is a park, the opportunity to have lots of roof surfaces really doesn't exist. Even the Music and Dance Theater is largely built underground, so the idea of using the PV in the wall system made a lot of sense," said

Uhler. "And we thought if we could find the right system, it would be an attractive façade for the building as well."

Maximum Impact from Minimalist Style

Hammond Beeby Rupert Ainge Architects (HBRA) is designing the pavilions as two minimalist-style, black-glazed cubes. These glass façades will integrate solar electric (photovoltaic, or PV) modules on the outside surfaces.

After extensive research and consultation, HBRA decided to use customized mono-crystalline PV modules, modified to function within a curtain wall system. A curtain wall is a non-load-bearing exterior wall that behaves as a screen. It can be made from a number of materials such as brick, stone, or, in this case, PV modules.

"All of the black on the façades you see is PV. We think it is perhaps the first of its kind in Chicago, perhaps even in Illinois," said HBRA architect Cyrus Subawalla. "The Exelon Pavilions are being designed to be demure in stature and to 'urbanistically' blend in with the formal symme-



Solar electric modules will be integrated into the glass façades on the Millennium Park's energy-efficient, black-glazed cube-style pavilions.

tries of the surrounding park landscape."

Subawalla also noted that the PV modules aim to meet the requirements and standards of the National Electrical Code as well as the Chicago Building Code. "We con-

sider this project a unique example that addresses important architectural issues of sustainability, context, and simplicity," said Subawalla.

The energy generated will es-
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SRP Celebrates 100 Years of Service

This year, the Salt River Project (SRP) celebrates 100 years of water and power service to the Phoenix, Arizona, area. The seventh of February, 2003, marked the centennial of SRP, with events commemorating the anniversary ongoing throughout the year. To honor the centennial, SRP held a gala reception in Washington,

D.C., on February 12, 2003. The reception included speeches by Arizona Senator John McCain, Congressman Jeff Flake, and other dignitaries. SRP and the community will be celebrating the centennial throughout the year with the Phoenix Museum of History's "SRP: The Power of Water" ex-
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U.S. Sen. John McCain (R-Ariz.), left, and SRP President Bill Schrader celebrate SRP's centennial at a reception at the Library of Congress.

Roseville Links Solar Generation To Popular Green Energy Program

By Vicki Mongan and Bev Van Arkel

For Roseville, California, Electric customers, green energy isn't just a product option. It's also the solar electric (photovoltaic, or PV) system on the new fire station, the large PV generation facility planned for the city's proposed energy park, the town's PV-powered aquatic center, the generous rebates for PV installation, and the innovative program with AstroPower and various home builders, such as Centex, whereby home buyers can add PV as an

upgrade.

Because supporting renewable generation is important to the city and its residents, the city's municipal utility has found a number of ways to bring solar and other green power to the community. One innovative approach is to allow customers to contribute to the utility's RE-New™ Green Fund. The fund is in addition to Roseville Electric's RE-Green50™ and RE-Green100™ programs that let customers pay a little extra to buy 50 or 100 percent of their power from renewable

sources. Customers contribute to the RE-New Green Fund with the understanding that their money will be used to build new, environmentally preferred renewable energy systems within the city limits.

Green energy is popular in Roseville, a 90,000-resident city near Sacramento with an average household income of approximately \$60,000. While the adoption level for green energy in most communities averages around one percent, nearly two percent of Roseville Electric customers par-
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Roseville's new fire station features an 18.2-kW solar electric system, just one of many PV systems in the city.

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Solar in the Land of the Rising Sun

By Tara Willey

Japan is leading the world in solar electric power. Not only is it the country with the most solar electric capacity installed, it also has the most ambitious plans for future solar and renewable projects.

In 2001, Japan had a total of 452 MW of solar electric installations, roughly 45 percent of the world's total of 982 MW. Germany and the United States, with 195 MW and 168 MW respectively, are a distant second and third. Over the past ten years, Japan has increased its installed solar electric capacity more than 20 times and prices have dropped by a dramatic

75 percent.

Unlike many other countries, Japan has financial and environmental drivers that have led to public demand and government support of solar. Because Japan relies on imported fuel, it is vulnerable to price fluctuations and must pay an added cost of importing the fuel. Additionally, nuclear power provides approximately 25 percent of Japan's electricity. By investing in local renewable energy sources, Japan can ensure more stable energy costs, become more energy independent, and realize many safety and environmental benefits.

Other nations face these is-

issues, but Japan's response is unique for two reasons: (1) the people demand renewables, and (2) the government has provided steady funding for renewables over a long period. Japan's electricity rates are almost twice as high as those in most of the United States, and renewables offer a mechanism for stabilizing and securing these rates. Also, because a large portion of its power is produced by nuclear, oil, and natural gas, renewable energy offers a clean alternative to mitigate environmental impacts of electricity generation.

The Japanese government has a long history of support for renewable energy. In 1974, the Agency of Industrial Science and Technology, part of the Ministry of International Trade and Industry (now Ministry of Economy, Trade, and Industry, or METI), began the Sunshine Project to develop renewable energy technology. A few years later, the Moonlight Project was established to address energy efficiency. The New Sunshine Program was initiated in 1993 by combining research and development activities, the Sunshine Project, and the Moonlight Project. The goal of the New Sunshine Program was to coordinate the efforts of the other three activities to create sustainable growth and address energy and environmental issues. Similar to the Million Solar Roofs Initiative



TEPCO's offices in the shadow of Mt. Fuji feature solar electric power.



The commitment to solar by Tokyo Electric Power Company, the world's largest independently owned utility, is evident by the installations on several of its facilities, including its Yamanashi Branch office, above.

SRP Celebrates Its Centennial

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hibit, the Centennial Waters fountain at the Chandler Fashion Center, and SRP will award several grants to help strengthen the community.

The Beginnings of SRP

The history of SRP began in 1902 as settlers began to seek solutions to the area's limited water supply. Residents of Phoenix and surrounding areas worked with U.S. President Theodore Roosevelt to develop the National Reclamation Act, which would allow money from the sale of public lands to be used to develop water resources. Arizona was the first state to benefit from this Act, and immediately began construction on the Theodore Roosevelt Dam, creating a massive lake 300 miles long and four miles wide that would supply water to the Salt River Valley.

On February 7, 1903, the Salt River Valley Water Users' Association was incorporated, and, under the National Reclamation Act, became the first water and power reclamation project, now known as the Salt River Project.

SRP Today

Today SRP is the third largest public power utility in the United States and serves more than 700,000 electric customers. SRP has had close ties to the community since its inception, when the Salt River Valley Water Users' Association provided 200,000 acres of private land as collateral for the government loan to develop the Theodore Roosevelt Dam. These ties continue today, as SRP has

recently implemented three grant programs for the local community. The SRP Heritage Grants will help local museums and organizations develop exhibits documenting the role of water and power in the community. The American Folk Life Center of the U.S. Library of Congress has cosponsored the Arizona Heritage Project, which has awarded \$3,000 grants to five high schools to explore the history of their communities. Six groups of SRP employees received SRP Volunteer Centennial Grants, totaling \$55,000, to improve facilities used for community service.

In addition to providing grants to improve the community, SRP is giving back to the community by generating renewable energy. SRP has invested more than \$29 million in solar energy, landfill gas, and low-impact hydroelectric power, and provides customers with a green pricing option. The green pricing program, EarthWise Energy™, allows customers to buy

locally produced renewable energy in blocks of 100 kWh at \$3.00 a block. The funds from EarthWise Energy are then used to build new renewable energy facilities or maintain the existing ones.

SRP's dedication to renewable energy has made it a leader in the solar community. SRP owns and operates three large PV systems totaling 400 kW and has installed solar on three local educational facilities. One of SRP's most recent solar projects is the installation of a covered parking solar electric system at the Red Mountain branch of the Mesa Public Library.

To stimulate residential customers to purchase solar electric systems, SRP's website, www.SRPnet.com, provides customers with useful information for on the background, costs, and energy production value of solar electricity. SRP is working with Calix Homes, and other builders, to include solar electric systems as features of some new homes.



SRP President Bill Schrader, left, and Congressman Jeff Flake celebrate SRP's centennial at a reception at the Library of Congress in February.

in the United States, METI actively promotes the installation of solar on rooftops in order to increase demand. Additionally, METI has enacted a renewable portfolio standard requiring all electric utilities to increase their use of renewables to 1.35 percent of total generation by 2010.

A contributing factor to Japan's success in expanding renewables is the cooperative effort among industry, government, and academic organizations. In recent years, the Japanese government has gradually reduced funding for renewables. However, rather than a decrease caused by lack of interest or a shift in focus, this funding reduction has been in response to a growing industry. The Japanese programs have led to increased demand and production, and there is enough momentum that the industry is gradually becoming self-sufficient. Japanese companies such as Kyocera, Sanyo, and Sharp have grown to have a strong presence in international solar markets as well. The goal for Japanese industry is full commercialization within a decade. Because of this strategy, the Japanese solar industry is well on its way to becoming self-sustaining, providing stiff competition to other countries' solar industries.

The world's largest independently owned utility, Tokyo Electric Power Company (TEPCO), exemplifies Japan's commitment to renewable energy. TEPCO has partnered with several nongovernmental organizations to develop renewable and clean energy programs that provide subsidies, information, and support to better serve its customers. Through its green pricing program, TEPCO purchases power at a premium from its customers that produce excess renewable energy. TEPCO's commitment to solar is highlighted by the large solar electric installations at several of its facilities.

The Solar Ark in Gifu

Not only is Japan home to one of the world's most aggressive solar programs, it is also home to one of the most striking solar installations in the world, the Solar Ark, which opened in April 2002 in Gifu, Japan. The Solar Ark is a crescent-shaped building, 315 meters long and 37 meters tall, with a façade covered by Sanyo solar panels. The project is designed to be a symbol of progress, leading the way to the 21st Century. The Ark, Japan's largest solar electric system at 630 kW, combines energy efficiency, water conservation, and renewable energy to serve a state-

of-the-art science center. Next year, the facility will add a solar array to the parking structure.

Japan's solar activities are a good example of how long-term planning and funding for solar electric power can leverage extraordinary results.

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The SEPA Record is a publication of the Solar Electric Power Association, a nonprofit association of energy service providers, solar electric (also known as photovoltaic or PV) module and component manufacturers, and installers, integrators, and distributors. The Solar Electric Power Association (SEPA) and its 120 members are increasing the use of solar electric business models to bring solar power into the mainstream. SEPA's energy service provider members supply 30 percent of U.S. electricity customers.

SEPA, formerly known as the Utility PhotoVoltaic Group, helps to establish standards for photovoltaic systems and their interconnection to the utility grid, hosts cross-industry workshops and conferences, and manages a variety of campaigns to educate energy service providers, policy makers, and commercial and residential customers about photovoltaics.

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Solar Hydrogen Combo Is 'Homegrown' Energy Solution

By Paul Scott

Progress toward a hydrogen economy is picking up to near "warp speed." Only two years ago, auto companies collectively signed on to the concept that hydrogen stored onboard was the easier path for a fuel cell vehicle. As of the end of 2002, a sixth hydrogen fueling station became operational in California. And, recently, we have had the President speaking the goal that "the first car driven by a child born today be hydrogen-powered."

It has become well-accepted that hydrogen fuel offers pollution-free transportation, with water as the product of either a fuel cell reaction or of combustion in a lean-burn, internal-combustion engine. Production of hydrogen from renewable sources, such as photovoltaics, promises to free the nation from the insecurity born of importing fuel from distant and volatile regions such as the Middle East. Hydrogen can be the "homegrown" energy solution, and there are growing indications of the will to make this happen.

The vision of abundant hydrogen energy has been before us since the days of Jules Verne, who wrote of energy from water. The use of solar photovoltaic systems, which turn the sun's energy to electricity, in combination with electrolysis to breakdown water into its hydrogen and oxygen constituents, was first demonstrated 20 years ago. The aerial photograph shows an early version of the PV hydrogen system which was sited at the El Segundo, California [U.S.A.], facilities of the Xerox Corporation. The electrolysis system (circled) was packaged in a 40-foot-long shipping container and shipped to the site, then surrounded with the PV array. This system supplied the fuel for a fleet of three maintenance trucks which had been converted to use hydrogen for fuel. Similar but larger systems were demonstrated in Germany.

Wind generation of electricity is developing, like PV, with worldwide growth rates in excess of 36 percent per year over the past several years. In many regions, wind generation offers a more economical means of electricity production, with amortized installed costs of four cents per kilowatt-hour or less. These rates, in combination with prepackaged electrolysis units, offer fuel for costs that may soon be competitive with common fuels manufactured from imported oil (taking into account the added efficiency of a

hydrogen-fueled engine).

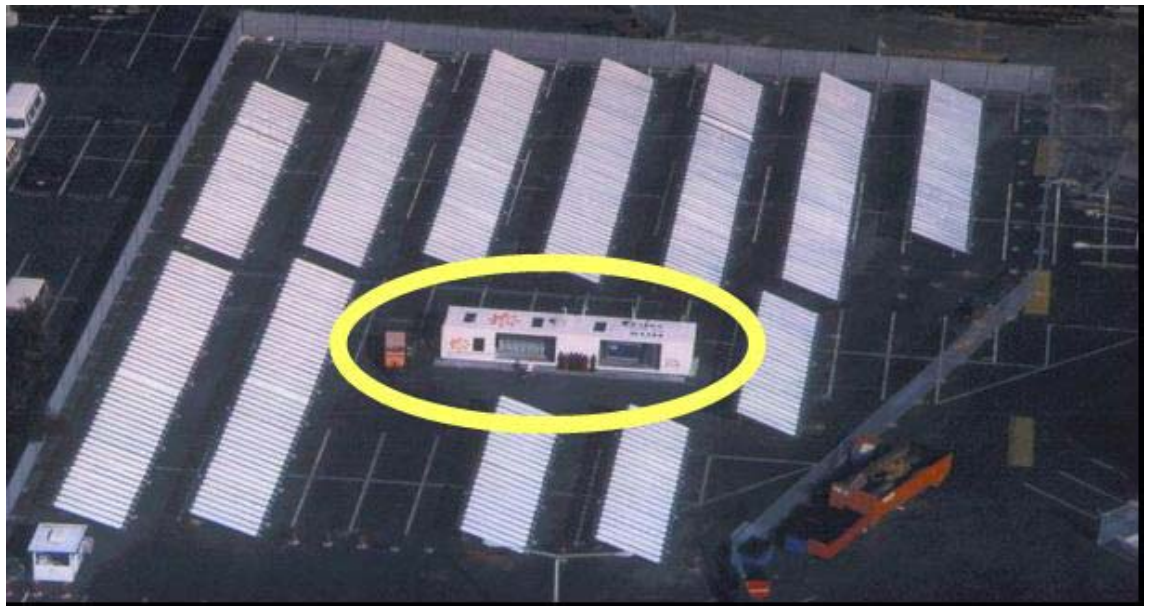
Iceland and Norway have discussed plans for making fuel from hydro and wind resources. The Japanese Environment Ministry has announced a plan under which the National Institute of Environmental Studies will study the use of offshore floating wind farms to produce hydrogen and pipe it to markets on shore.

The Los Angeles-based South Coast Air Quality Management District, in combination with the U.S. Department of Energy, has a more down-to-earth plan for a wind-hydrogen system, using power from the three turbines in photo below. On average, this pilot system will produce about 65 kW electrical power and one kilogram hydrogen per hour (and over three times that in full wind conditions). This wind hydrogen system, being installed in North Palm Springs, California [U.S.A.], will have the capability of fueling a fuel cell bus for approximately 12 hours of service per day. Modern turbines, of 1.5-megawatt capability, could *each* provide fuel for six to eight buses or approximately 500 cars.

The variable nature of wind or sun availability must be understood and accounted for in the design of systems that are required to make fuel available every day. Energy storage requirements vary widely from site to site, but at best will involve several days of storage. As a more demanding example, the Palm Springs wind blows strongly in the summer, but is absent for large periods of the winter. Storage requirements in such areas can be as costly as the wind turbines themselves, especially if geologic formations are not available for storage or if—as in the Palm Springs area—there are earthquake concerns.

Although PV, wind turbine, and hydrogen technologies are in a rapid state of development, it is already evident that, *with investment*, a major shift from fossil fuels to "home grown solar fuel" can follow. Large-scale implementation can follow the availability of buses and cars at acceptable prices. Providing fuel for significant numbers, say 100,000 cars, conveniently dispensed at service stations, will require initial investment of hundreds of millions of dollars. This investment, however, provides fuel for three million miles per day. One estimate of the cost of this transportation investment suggests an amortized cost of five cents per fuel cell car mile!

The recent introduction in the



This aerial photograph shows an early version of a hybrid solar electric power hydrogen system located at the El Segundo, Calif., facilities of the Xerox Corporation. The circled electrolysis system, where the hydrogen is generated, was packaged in a 40-foot-long shipping container and shipped to the site, then surrounded with the PV array. This system supplied the fuel for a fleet of three maintenance trucks.

California Legislature of a bill to authorize a bond issue vote including \$500 million for hydrogen infrastructure offers one possible way of "jump starting" the process of putting in generation and distribution. By such means early stages of implementation of hydrogen fueling stations may be sponsored by government teamed with energy firms, but full implementation will only follow with assurance of a profitable fuel product. (This, in turn, rests on innovative introductions of attractive hydrogen-fueled vehicles by the auto firms.)

Localized, small systems are also attractive. There are more than a handful of customers in remote locations with interest in purchas-

ing a small "personal" solar or wind system that includes the capability to produce and make available a tank filling every few days. True energy independence, "Home Power," follows only if one can operate off the grid. To do so requires equipment with special design and characteristics, going well beyond simply adding solar panels or a wind turbine. The compressor and electronics, for instance, may have to be specially controlled to operate over a range of input power. Most notably, a full commitment of business and government will be required to develop such systems for mass production so as to make them available with low cost and reliable operation characteristics.

Public opinion regarding a hydrogen-fueled economy has quickly shifted from ignorance through skepticism to acceptance of hydrogen as the fuel of the future. This shift could become a forceful demand as the public begins to perceive the sun as the source and their well being to be dependant on a rapid shift from imported towards homegrown "green" fuels. Each of us with experience related to PV, wind, and hydrogen are blessed with a "once in an eon" responsibility to participate in the education and planning of this transition.

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Chicago's Millennium Park Blends Solar, Architecture

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essentially power both pavilions, working toward self-sufficiency and cost efficiency. In addition, the pavilions' double wall system will reduce energy consumption costs. Through the wall's ventilated cavity, each building's heat loss or gain will be minimized.

When completed, both pavilions will serve multiple roles of being park public information centers and display zones for Exelon Corporation and the Chicago Park District. Specifically, the West Pavilion will have Exelon exhibit space, park offices, and client-specific amenities. The East Pavilion will have additional exhibit spaces, including information about the value of PV and how it generates power for the pavilions.

A Public-Private Partnership

The pavilions are a portion of an overall city effort to build and enhance Millennium Park. Funded by city and private funds, the Millennium Park project is a joint venture intended to enhance park, recreation, cultural, and transportation facilities along Chicago's Lakefront.

"It's a public-private partnership initiated by the Mayor of Chicago, starting in 1997," said Uhlir. "The individual, privately funded

projects within Millennium Park are what we call park enhancements, of which the Exelon Pavilions are one of those."

The park, two-thirds of which will be entirely new parkland, covers what was formally a surface parking lot and existing railroad tracks and terminal, which remained. This had long been considered unsightly space that occupied a major portion of the city's "front yard."

Although the Exelon Pavilions will not be completed until next year, parts of Millennium Park are already open to the public. These include the popular McCormick Tribune Plaza and Ice Rink, the Millennium underground parking garage, and landscaped parkland of over 400 trees.

The energy-efficient pavilions are just one aspect of the City of Chicago and Exelon's partnership to support sustainable design and renewable energy. In 2002, the McCormick-Tribune Plaza and Ice Rink was the location for the *Earth From Above* exhibit, an internationally acclaimed outdoor exhibition by world-renowned aerial photographer Yann Arthus-Bertrand. Presented by Exelon Corporation in cooperation with the Chicago Department of Cultural Affairs, *Earth from Above* was Millennium Park's inaugural exhibition.

ComEd provided PV to illuminate the exhibit. When *Earth From Above* closed in September 2002, the PV batteries were donated to Chicago's 911 center and the solar panels were used to support other renewable initiatives.

Other park enhancements currently under development include the indoor Chicago Music and Dance Theater designed by HBRA; an outdoor Music Pavilion designed by renowned architect Frank Gehry; a 100-ton reflective sculpture by artist Anish Kapoor; and a 2.5-acre garden whose design was part of an international competition won by Gustafson Guthrie Nichol.

When completed, Millennium Park is expected to be Chicago's newest world-class destination for families, tourists, and convention-goers. According to the Public Building Commission of Chicago, Millennium Park will guarantee the city new jobs and revenues for decades to come. Conservative estimates say it could generate \$100 million to \$150 million of new tourist revenues each year.

Gabriela Martin is Manager of Environmental Commitments at Commonwealth Edison (ComEd) headquartered in Chicago, Illinois, and oversees the renewable energy project development at ComEd.



The South Coast Air Quality Management District, based in Los Angeles, California, in partnership with the U.S. Department of Energy, uses a hybrid wind-hydrogen system, powered by these three turbines.

Small Solar Sends Big Message in the City of Tucson

By Joe Salkowski

Although Tucson Electric Power Company has built one of the world's largest photovoltaic power systems, the utility's smaller solar arrays attract far more attention.

The solar arrays that Tucson Electric Power (TEP) has deployed throughout its hometown are dwarfed by its giant 2.4-megawatt system in the high desert near Springerville, Arizona. But the smaller systems, installed in urban schools, parks, and other public spaces, produce an even more powerful message about the merits of solar energy.

"We want to give people some examples of solar power that they can see and be a part of," said Betsy Bolding, TEP's director of consumer affairs and a spokeswoman for the company's solar programs. "We want the community to become more comfortable and familiar with photovoltaic technology."

TEP's Community Solar Projects range from a 43.2-kilowatt system at a local water treatment plant to a 0.75-kW array installed on a house built for low-income residents by Habitat for Humanity Tucson. They also include 44 kilowatts of capacity installed on the rooftops of customers who participate in TEP's SunShare program, which provides incentives for residential use of solar power.

In all, the projects produce nearly 150 kilowatts of solar power, helping TEP satisfy an environmental portfolio standard established by the Arizona Corporation Commission. The standard requires the state's electrical utilities to generate 1.1 percent of their electricity through renewable resources by 2007. At least 60 percent of that amount must be solar electric energy.

"With the cost of photovoltaic material as high as it is today, large systems like the one in Springerville offer some real advantages in terms of economies of scale," said Tom Hansen, vice president and technical advisor for TEP. "But through SunShare and our other community projects, we've been able to pass along some of the benefits of buying at mass quantities to these smaller systems."

Several of those smaller projects are located at schools, where students have participated in both designing the systems and integrating them into lesson plans focused on renewable energy. For example, the photovoltaic panels installed in a 4.8-kW system at Safford Middle School provide shade for an outdoor porch where students sometimes gather for science lessons.

"Part of the challenge was building something that was visible and that students could interact with," said Doug Crockett, natural resources manager for the Tucson Unified School District (TUSD). "It's hard to justify solar power on a strict economic basis right now, but we want to emphasize its educational value."

Both Safford Middle School and Palo Verde High School, site of a rooftop four-kilowatt solar system, serve as science and technology "magnets" in TUSD's



Teachers at Safford Middle School often use this porch, shaded by a 4.8-kW solar electric power system, to conduct class, enabling students to experience the workings of a solar electric power system up close.

court-ordered desegregation plan. Magnet schools offer specialized curricula to attract students from across the sprawling district.

"It's really important for students who express some interest in renewable technology to have exposure to what a solar panel does, what it puts out, and how that output changes over the course of a season," Crockett said. "We really try to engage them."

Indeed, Crockett is hoping to test a theory that students at schools with photovoltaic systems post improved science and math scores on standardized tests. Such a correlation was found by one study in Ohio, he said, and he hopes to prove the same in TUSD schools that boast solar systems built in partnership with TEP.

Solar-powered education is also featured at the city of Tucson's El Rio Center, where a seven-kilowatt system helps provide energy to classrooms used for adult education. The city also has teamed up with TEP to build a five-kilowatt system at Tucson's Southeast Service Center and a 43.2-kW system at the Hayden/Udall Water Treatment Facility.

When the city's electric rates were reduced by one percent in 1999, the city devoted the savings—about \$160,000 a year—to developing solar power projects, said Vinnie Hunt, energy manager for the city's operations department.

"The mayor and council wanted to do something that would pull the market ahead and help drive down the cost of solar power," Hunt said. "We also want to help local architects and engineers get more used to working with solar. That way, when the price of solar power does come down, we'll have some people with a track record in the community who can teach by example."

The city secured a \$75,000 grant from SEPA to fund development of the Hayden/Udall array. After the project was complete, SEPA recognized TEP and the City of Tucson for outstanding achievement in the development of a sustainable solar business during its 2002 Awards for Solar Business Achievement.

TEP provided inverters for that project and passed along other materials to the city at cost. The company also provided de-

sign and installation support and has committed to maintaining the facility.

Such public projects and others at popular local attractions like the Reid Park Zoo and the Pima Air Museum can serve as examples for homeowners who aspire to add photovoltaic panels to their own homes. They also encourage participation in TEP's GreenWatts program,

which gives customers a way to support renewable power projects by adding a small fee to their monthly bills.

"Our customers might be more eager to invest in GreenWatts if they see that the money is being invested in their community," Bolding said.

For now, TEP's Community Solar Projects play a relatively modest role in TEP's renewable

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participate in the green energy program. And the participation is growing daily.

Even with better-than-average participation, Roseville Electric was aware it would take some time for the RE-New Green Fund to support a renewable energy project of any size. To stretch contribution dollars, the utility takes it one step further by matching all green purchases and using the total to fund renewable energy projects that show RE-New Green Fund dollars at work in the community. Additional Public Benefit Fund dollars are earmarked for renewable generation as well.

Showcasing Renewable Generation

The most recent project is a sophisticated PV system installed on the city's eye-catching new fire station. The rooftop array generates enough energy to power more than three typical Roseville homes each year. The system, designed and installed by Global Solar Energy of Tucson, Arizona, uses 72 ASE 300 solar modules connected to nine SMA 2.5-kW string inverters to produce 18.2 kWac of peak power. The system is monitored by an SMA SunnyBoy data acquisition control system that integrates data from all nine inverters and the onsite weather station to provide comprehensive information for analysis. This solar power performance data will be made available to the public soon through the Roseville Electric website at www.RosevilleElectric.org.

"We felt it was important for RE-New Green Fund contributors to see results from their efforts,"

said Roseville Retail Services Manager Carla Johannesen. "By placing the PV system on a community landmark, we are drawing attention to renewable energy. The system's sophisticated data-capturing capability adds even greater value by providing critical performance data we can use to design future city systems and to help residents and businesses make the best use of PV power."

The 120 kilowatts of PV installed in Roseville is just the start. Roseville has ambitious plans for further locally sited PV generation.

Roseville Electric has actively promoted the fire station's PV system on its website, in the press, and on local television.

"The more people who see a tangible result of the RE-New Green Fund and Public Benefit Funds, the more interest we generate in renewable energy and our green energy programs," said Johannesen. "By getting the word out about our green energy programs, we are giving our customers a direct say in the kind of electricity they wish to utilize. The fire station project also successfully demonstrates the viability of solar power in our community."

Other Renewable Incentives

Roseville Electric has also used its Public Benefit Funds to support rebate programs for customers who install their own PV systems. The utility first developed interconnection contracts to allow PV systems that generate less than 10 kW to connect to the Roseville distribution grid. In addition, the utility coordinated with national homebuilder Centex Homes and PV manufacturer AstroPower to install 2.4-kW PV

power portfolio, which includes about 2.8 megawatts of company-owned solar arrays and a 5.5-megawatt methane gas project. But Hansen predicts that smaller photovoltaic systems will become much more important to the company's future when solar power becomes more affordable.

"In the long run, the most realistic use of solar power and the most benefit to the utility will come from distributed generation, having a little bit of generation on everybody's premises," he said. TEP can help that process along, he said, by encouraging the use of such small-scale solar systems in the community.

"We've got to get the product out there so that people can see how it works," he said. "We need people to realize that solar is a good thing: it won't burn down your house, but it will bring down your electric bill. If people see their neighbors putting in solar systems, they just might decide they need one for themselves."

Joe Salkowski is the Corporate Communications Specialist at Tucson Electric Power Company.

systems on 30 new homes being built in Roseville.

The utility's staff members stay abreast of current industry developments so they can act as resources to customers interested in renewable generation and energy-efficient technologies. When a customer expresses interest or has questions about generation and energy efficiency alternatives, utility employees ensure they are available to help or to direct the customer to more knowledgeable experts.

"Energy efficiency and renewable generation must go hand-in-hand," stated Roseville Electric's Green Energy Program Coordinator Bev Van Arkel.

Looking to a Bright Green Future

Roseville Electric also anticipates using combined RE-New Green Fund and Public Benefit Fund dollars to help finance a large photovoltaic generating facility as part of the city's proposed energy park. The park's PV farm could generate as much as 1,800 MWh per year, enough to power more than 180 Roseville homes annually. This is in addition to a commitment to purchase four megawatts of green energy through market purchases over the next five years to meet the city's new renewable portfolio standard.

The city's strong commitment to green energy has been a driving force behind exploring innovative ways to bring solar to the community on a public and private level.

Vicki Mongan is a freelance writer. Bev Van Arkel is Roseville Electric's Green Energy Program Coordinator.

Large Corporations Install Larger Solar Electric Systems

PowerLight Helping Customers Realize the Benefits of Clean, Reliable, Renewable Solar Power

By Tara Willey

The California energy crisis shocked residents with skyrocketing electricity prices. Now the turmoil in the Middle East threatens the entire country with the same unpredictable energy costs. Owners of solar electric systems know where their power is coming from and have paid their electricity costs up front. Large corporations, which often pay peak electricity rates, have recognized the long-term financial benefits of solar and are purchasing bigger and bigger solar electric systems. There is a growing trend of companies installing larger and larger PV systems, taking advantage of the economies of scale.

Johnson and Johnson is a prime example of a large corporation that has "gone solar." Neutrogena, the Cordis Corporation, and Janssen Pharmaceutica, all Johnson and Johnson companies, have installed large PowerLight solar electric systems at their facilities. In August 2001, Neutrogena was the first of the companies to install solar on its headquarters located in Los Angeles. The Cordis Corporation installation, completed in May 2002, faced a unique barrier: the build-

ing was not owned by Cordis, so the project had to deliver a financial return that coincided with the terms of the buildings lease. By pairing New Jersey's Clean Energy Funds with other sources, Cordis was able to make sure the investment would pay off prior to the end of its lease. Earlier this year Janssen Pharmaceutica installed a 500-kWp system at its headquarters in Titusville, New Jersey, the largest solar electric system in New Jersey.

In addition to the Johnson and Johnson projects, PowerLight has recently worked with several other businesses and local governments to deliver solar electric systems. The City of Vallejo recently installed and dedicated PowerLight systems at the Vallejo City Hall and the John F. Kennedy Library. An information kiosk in the lobby of City Hall allows visitors to see real-time system performance and to learn about the benefits of solar energy. Vallejo's commitment does not end with these projects. A 31-kW solar installation was installed at Vallejo's police station and the City has plans for a solar array to power water pumping stations in the northeast quadrant of the City.



Challenging the Status Quo: The Domaine Carneros Winery in Napa Valley, California, features a 200-kW PowerLight solar electric system that supplies up to 40 percent of the winery's electricity needs.

On 22 April 2003, Toyota completed the largest green building complex in the United States, housing a 536-kW PowerLight solar electric system. This building complex is unique in its combination of energy-efficient designs, solar electric power, a hydrogen fueling

station, and other green building technologies. Other clients that have recently completed or announced plans for PowerLight systems include: the U.S. Navy, the U.S. Postal Service, Whole Foods Markets, Domaine Carneros Winery, and Cypress Semiconductors.

PowerLight has experienced explosive growth since it was founded in 1991 and its products are well-suited for commercial customers. The company has developed a niche market by utilizing the economies of scale for large PV systems. The huge demand for PowerLight products, and for large systems in general, can be attributed to economics. Companies such as Johnson and Johnson and Toyota are going solar because it makes sense financially. By purchasing PV, these companies are stabilizing their electricity expenses, avoiding electricity price spikes, and developing an environmentally conscious image. For an industry that has struggled over the years to develop an eco-

nomically viable product, this is big news.

President and founder of PowerLight Corporation, Tom Dinwoodie, is not surprised by PowerLight's growth. "The PV industry is an extraordinary success story," he said, "it's an optimistic example of challenging the status quo and addressing global warming."

With existing rebates, the cost of solar electricity becomes increasingly comparable to that of electricity generated from traditional sources, such as fossil fuels and nuclear power. But the environmental benefits of renewable energy are becoming more relevant. As the issue of climate change gains attention, people are hedging their bets to ensure they have a steady supply of clean green power.

For more information about PowerLight, please visit its website at www.PowerLight.com.

Tara Willey is Program Coordinator for the Solar Electric Power Association.



In March, the City of Vallejo, Calif., dedicated this solar electric system, located on the roof of the City Hall.

Renewable Generation R&D Grows in Sacramento

By Bruce Vincent

In 2001, the Sacramento, California, Municipal Utility District (SMUD) was awarded a \$13.6 million contract by the California Energy Commission's Public Interest Energy Research (PIER) program to fund a renewable generation research and development program. The program was cleverly named the ReGen R&D Program. The ReGen program is designed to meet the needs of SMUD, the state of California, and electric utilities nationally working to promote the use of solar electric (photovoltaic, or PV) energy. The goals of the ReGen Program are to:

- develop and demonstrate new and advanced renewable generation technologies;

- develop programmatic resources that will help SMUD increase the use of photovoltaics in its service area;

- develop technologies to help SMUD reduce the summer peak-period demand for electricity; and

- establish Sacramento as a center for the development, testing, and implementation of renewable generating technologies.

The ReGen Program has planned 19 projects conducting research in photovoltaics, biomass, wind, and solar concentrator technologies, as well as several projects related to SMUD's program development and execution. Of the Program's 19 projects, 14 are PV-related (including a project led by SEPA to address solar electric markets and technologies), two develop concentrating solar technologies, two focus on biomass, and one funds the development of a new wind technology. Most of the ReGen contracts were signed by mid-2002, and almost all are now well underway.

Several of the projects have reached their mid-point or further and some have already resulted in products that have reached the market. This article will highlight those projects most developed.

Distributed Generation Geartrain for Megawatt Turbines

Clipper Windpower is working on a project to develop a gearbox for wind turbines that will operate well at low wind speeds and require less maintenance than units now being installed. The Clipper machine utilizes multiple planetary gears and multiple generators. It is expected to significantly reduce installation and maintenance costs. It will be used to either retrofit existing turbines or be incorporated into new turbine designs.

Preliminary research into costs, gear sizing, and other factors has been completed, and a prototype is being assembled at the National Renewable Energy Laboratory (NREL) for testing. NREL is providing match-share funding for the testing and funding from the ReGen Program has enabled Clipper to obtain a product-development grant of about

\$8.5 million from the U.S. Department of Energy. Most of the work under the ReGen contract will be completed in 2003.

Optimization of Residential Photovoltaic Systems

AstroPower is developing a building-integrated photovoltaic (BIPV) system for residential rooftops with the goal of making it easy and more affordable for customers to purchase and install residential rooftop PV systems. AstroPower will provide packaged, grid-connected PV systems with improved aesthetics, functionality, and usability at a relatively low cost. The packaged system will include a module/laminate product, a power conditioning unit, and a meter that will give the homeowner information on the PV system.

The BIPV systems are already being installed in a production housing project. Although the product is on the market,

AstroPower will continue to work on research to allow greater flexibility of applications for its residential product.

Laminate and Batten PV Roofing System

Uni-Solar is developing a BIPV roofing system for installation on new or existing roofs with any type of solid, continuous under-structure. Architects and residential developers have often expressed a desire for an aesthetically pleasing BIPV system, the more unobtrusive the PV, the better. Installed PV systems will be virtually indistinguishable from a dark blue, standing-seam, sheet-metal roof. The design focuses on developing a mounting structure that is simple to install and low in cost, and the flexible panels are expected to greatly reduce the cost of shipping.

Three field trials have been completed and others are scheduled.

See REGEN, p. 8, col. 1

Green Power Goes Mainstream

By Tara Willey

Late last year, SEPA signed up as an EPA Green Power Partner, a program designed by the U.S. Environmental Protection Agency to encourage the purchase of green power, speed the adoption of renewables, and provide guidance to green power purchasers. Earlier this year, SEPA began its search for a green power provider, and the search is over! SEPA has chosen to purchase 100 percent solar green tags (or tradable renewable certificates, TRCs) from Sterling Planet.

The SEPA Board felt that it was appropriate for the organization to "walk the walk" and show its commitment to renewable energy. The Board committed SEPA to being a Green Power Partner at the EPA Green Power Leadership Club level, meaning SEPA would purchase 60 percent of its energy from renewable sources.

SEPA doesn't actually pay an electric bill, though—the cost is incorporated into its office lease—so how does it purchase green power? Not a problem. SEPA worked with the EPA to estimate the power usage based on the square footage of office space and then purchased green tags for 60 percent of that power usage.

There were a number of options available to SEPA for purchasing green tags; however, Sterling Planet was able to offer 100 percent solar energy, Green-e certified green tags at a reasonable price. Green-e is a certification and verification program for green power products which ensures that customers get what they are paying for when buying green power. Sterling Planet is a company dedicated to giving everyone the option of purchasing green power with its program Green America. Sterling Planet sells green tags generated from newly developed renewable energy facilities that generate electricity from the sun, wind, geothermal, low-impact hydropower, and biomass.

The EPA's Green Power Partnership Program was developed to provide information and guidance to businesses and organizations that are interested in purchasing green power but need some additional help. The goal of the Partnership is to standardize green power procurement as part of best-practice environmental management. Partners in the program make a commitment to procuring green power for a percentage of their electricity needs. In return, the EPA provides technical assistance and public recognition. The Green Power Partnership is a voluntary effort and the EPA recognizes those Partners that have made extraordinary commitments to renewable energy. Green Power Partners have access to the EPA's extensive resources and knowledgeable staff.

Almost 140 businesses and organizations have joined the Partnership since its inception, raising the visibility of renewable energy and simplifying the purchase of green power. For more information, visit www.epa.gov/greenpower.

Green power is produced by wind, solar, geothermal, some forms of hydroelectricity, and biomass. These energy sources generally have little or no environmental impact, especially when compared to traditional energy sources such as

oil, large-scale hydro, coal, natural gas, or nuclear. Green power is usually more expensive than traditional energy sources. As the market grows, however, the costs will come down. In the meantime, green power has many benefits that are difficult to quantify but should be considered, such as environmental and health benefits, reduced reliance upon fossil fuels, and increased energy independence.

Green power can also have economic benefits. Electric bills are subject to rate fluctuations, but many customers of green pricing programs can sign long-term contracts to purchase green power at a fixed rate. When fossil fuel rates spike, the rates for green power remain stable.

Most often when customers purchase green power, the actual electricity generated by the renewable

suppliers. For example, in Pennsylvania, there are four different retail green power marketers competing for customers.

For those whose utility does not offer a green pricing program or renewable energy option, tradable renewable credits or "green tags" are another option. Green tags represent the attributes of renewable energy—such as the environmental benefits—apart from the electricity generated. Customers should consider a few things when purchasing green tags, such as the mix of renewable energy, the cost, the location of the energy source, and the newness of the renewable resource. There are currently about a dozen vendors marketing green tags nationwide.

The third option for shifting to renewable energy is onsite generation: installing a renewable energy



These three wind turbines, located in Somerset County, Pennsylvania, annually supply 9,375 megawatt-hours of green power to American National Wind Power and Green Mountain Energy customers.

source goes directly to the grid; the customer is paying for the attributes of that electricity and to displace nonrenewables from the grid. This can be boiled down to supply and demand.

There are generally three ways people can purchase green power: grid-based green power (through an electric utility or green power marketer), renewable energy certificates, or onsite generation.

Some electric utilities offer customers the option of purchasing green power through green pricing programs. These programs are often structured so that the customer pays a flat rate to buy a fixed amount of their electricity from renewable energy. Customers usually have a choice of buying "blocks" of power at a premium price, allowing them flexibility in choosing how much green power they want to use. Because customers sign up through their utility, any additional charges for green power show up on their monthly electricity bill. Currently there are about 300 utilities around the country that have a green pricing program.

Some electricity customers who live in areas that have restructured their electricity markets can get green power from competitive

system (solar or wind is most likely) directly at the home or business. While this option is the ideal for a renewable future, the upfront costs can be prohibitive for many individuals and businesses. For those who do make the choice to install a solar electric system or small wind turbine, their energy costs are known and stable for the life of the system. There are a number of options to reduce the cost of solar or wind, including tax breaks and rebates, depending on the location and electric utility.

Green power has never been so accessible. Grid-connected green power is currently available to roughly 40 percent of U.S. customers and the innovation of green tags means that green power is available nationwide today. Companies such as Sterling Planet and programs such as the Green Power Partnership are making green power purchases simple and affordable. By purchasing 100 percent solar green tags and committing to the Green Power Partnership, SEPA is doing its part to help grow the market for solar and renewables, and encourages its members and other businesses to do the same.

Tara Willey is Program Coordinator for SEPA.

Cuba Basks in Power From the Sun

By Holly Riester and Tara Willey

It makes sense that Cuba would have an aggressive approach to using solar energy. After all, the sun is one of Cuba's most prominent resources. Trade embargos and Cuba's economic crisis have created an ideal scenario for renewable energy.

Cuba had a well-developed electricity grid that relied on low-cost petroleum purchased from the Soviet Union. That came to an end in 1989 with the fall of the Soviet Union. Cuba could no longer afford the market rate of petroleum and was forced to search for other means. Energy efficiency and renewable energy were the answer.

Today Cuba relies on solar, wind, biomass (in the form of sugarcane), and small hydroelectric, in addition to traditional energy sources. Rural electrification has been a high priority and solar has played the starring role. Thanks to Cuba's prolific sunshine and solar's modularity, solar electricity is often the technology of choice. Solar is economical when compared to extending power lines. It has the added benefit of not needing fuel. Diesel generators would be an option; however they are dirty, noisy, and require regular shipments of fuel.

Rural electrification projects in Cuba have helped improve the quality of life; allowing people to get an education and dramatically improving healthcare for Cuba's rural population. Solar in Cuba has provided electricity for more than 2,000 schools, enabling students to have a better education, resulting in improved literacy and a more educated society. Solar is also used for home lighting, radio, television, street lighting, water pumping, cooking, and other community services.

Isolated communities in Cuba stay connected with the help of the sun. The Halcon Solar ferry is a solar-powered boat that can transport up to six passengers, plus the captain, between communities located along Cuba's rivers. The Solar Ferry is powered by a 990-watt solar electric system, has six batteries for storing back-up power, is pollution free, silent, and can navigate shallow water. Community groups, environmentalists, and the government are considering expanding the fleet of solar ferries to serve a larger portion of the population and to enhance tourism.

Solar has perhaps been most influential on healthcare in Cuba. A few years ago, Cuba undertook an impressive initiative to use solar electric power to electrify all rural health clinics. This initiative has been enormously successful and most clinics are now powered by the sun. The solar electric systems at many clinics also power radio telephones, enabling the doctors to communicate with larger towns to request additional medical supplies or help in case of an emergency. The solar electric systems also provide power to refrigerate vaccines and for electrical medical equipment. This has resulted in reducing infant mortality, alcoholism, and overall improved health. The improved educational and medical conditions have meant that the average birth-

rate has decreased and the average age of women at their first pregnancy has increased.

Cuba is recognized internationally for its use of renewable energy to improve the quality of life for its people. The 19th Annual Latin American Conference on Rural Electrification (CLER) was held in Havana, Cuba, on 5-10 May 2003. Since 1964, CLER has been held bi-annually in a Latin American country. Cuba was selected as the host for this year's event because of its numerous renewable energy projects addressing rural electrification.

Holly Riester and Tara Willey are Program Manager and Program Coordinator, respectively, for the Solar Electric Power Assn.

Tap into SEPA's Expertise

Current Members

SEPA members are encouraged to use its staff expertise in the fields of program management, program evaluation, interconnection, project implementation, and system performance and costs. Members have already contracted with SEPA to use this expertise to help shape future solar electric projects, address market barriers, conduct economic analysis, and hold educational workshops.

SEPA participation in member projects can benefit both the member and SEPA. It brings the collective knowledge of the organization and its staff to member projects, and it also enhances staff experience for support of SEPA priorities.

Contact SEPA today and explore how SEPA can support your project or program.

Prospective Members

Membership in SEPA will connect your business or organization to a large network of energy service providers, solar electric manufacturers, and others in the solar and energy industries. SEPA provides value to its members by:

- Creating networking opportunities with members that have first-hand PV program and installation experience;
- Enhancing visibility of solar activities;
- Sending out leads for funding opportunities;
- Issuing publications on solar electric issues;
- Providing membership discounts for its annual conference and exhibition, and other SEPA organized events;
- Publishing its annual energy service provider and PV industry directory; and
- Providing access to online PV news and members-only website.

Contact SEPA today to find out how to become a member and to take advantage of these resources.

ENERGY SERVICE PROVIDERS

Alabama Power Company

www.albamapower.com

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Email: dmboylan@southernco.com

As a Southern Company family member, Alabama Power participates in the EarthCents Solar program. Customers can pay an additional fee per month to purchase renewable energy that will displace other types of generation on the Southern Company grid.

Alameda Power & Telecom (California)

www.ci.alameda.ca.us

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More than 80 percent of Alameda's power is generated using renewable resources. Alameda Power & Telecom currently has a four-kilowatt solar photovoltaic system on the Service Center roof, where it is collecting data on the system's performance. Alameda Power & Telecom plans to increasingly use PV as part of its energy mix.

American Public Power Association

(Washington D.C.)

www.appanet.org

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The American Public Power Association provides information and education to its public power utility members about energy efficiency and renewable energy topics, including PV, through workshops, conferences and newsletters. The APPA's Demonstration of Energy Efficient Developments (DEED) program sponsors and conducts activities related to energy innovation and improving efficiencies or lowering costs in the provision of energy services to the customers of locally controlled, consumer-owned electric utilities. The DEED program has provided funds for a number of photovoltaic projects.

Arizona Electric Power Cooperative, Inc.

www.aepnet.org

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Arizona Electric Power Cooperative, Inc., promotes solar energy throughout Arizona through its SunWatts program. With SunWatts, customers can take part in a variety of programs that foster photovoltaic energy. AEPCO assists its members with solar equipment purchases and leases, as well as offers a green pricing alternative. In addition, AEPCO has partnered with local industry and educational institutions on PV projects.

Arizona Public Service

www.aps.com

Mr. Cassius McChesney

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Ashland Department of Electric Utilities (Oregon)

www.ashland.or.us

Mr. Dick Wanderscheid

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The Ashland Solar Pioneer Program is a result of a unique partnership that combines the efforts and the financial resources of a number of organizations, both public and private, and more than 250 Ashland citizens and businesses to bring solar power to Ashland. The Solar Pioneer Program has resulted in three installations—a 20kW system and educational kiosk at the Ashland Civic Center, and two 5 kW systems at the Oregon Shakespeare Festival and Southern Oregon University.

Barbados Light & Power Company (Barbados)

www.blpc.com.bb

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Bowling Green Municipal Utilities (Ohio)

www.bgohio.org/public-utilities.htm

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Braintree Electric Light Dept. (Massachusetts)

www.beld.com

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Braintree Electric Light Dept. (BELD) is working on implementing a photovoltaic project in the Braintree school system. A solar electric system will be installed on the rooftop of the two middle schools in the town. Each system will be connected to a computer located in a classroom in each school. The computer will be used for data acquisition and record such information as power produced, wind speed, ambient air temperature, and sunlight amounts throughout the day.

Clallam County PUD (Washington)

www.clallampud.net

Mr. Dave Johnson

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Clallam County PUD offers its customers a low interest loan for the purchase of energy efficient items including photovoltaics. The loan is offered through First Federal Savings and Loan with the PUD paying the loan fees. This loan is available for existing homes (site built and manufactured) and small commercial businesses.

Commonwealth Edison Company (Illinois)

www.chicagosolarpartnership.org

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Commonwealth Edison (ComEd) is committed to supporting clean and renewable energy sources. As part of its efforts, ComEd is investing \$12 million in photovoltaics (PV). To encourage the development of renewable energy in its service territory, ComEd customers who install PV systems or wind turbines (up to 40kW) on their property can sell excess electricity back to ComEd. ComEd's interconnection guidelines are simple and it has adopted the IEEE929 interconnection standards. ComEd, the city of Chicago, the Illinois Department of Commerce and Community Affairs, the International Brotherhood of Electrical Workers and Spire Solar Chicago are pooling funding and expertise to support the development PV in Chicago.

CSG Services (Texas)

www.csgrp.com

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CSG Services, Inc. is a for-profit affiliate of Conservation Services Group (CSG) offering a full line of renewable energy services including renewable energy power plant development, project management, policy consulting, education and training, and information technologies and data collection. The Advanced Energy Division of CSG Services, Inc. has developed innovative programs involving consumer education, solar schools, and renewable energy credit management. The staff works with clients to provide customized, turnkey solutions for integrating the benefits of renewable energy resources to meet their goals. CSG works with small and medium sized renewable energy generators to help certify and broker their renewable energy credits.

DTE Energy (Michigan)

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DTE Energy's principal operating subsidiary is Detroit Edison, which has two solar facilities in its service area under its award-winning SolarCurrents program. Several additional installations have been made by Detroit Edison, including an installation at Detroit Cass Technical High School. DTE's subsidiary, DTE Solar Energy Company of California, has completed three other installations. DTE's SolarSchools

curriculum provides renewable energy education to students in K-12. A DTE representative serves on the Board of Directors of the Great Lakes Renewable Energy Association, and has assisted with developing a Professional Certification Program for designers, integrators and installers of grid-connected PV systems.

Edison Electric Institute (Washington, D.C.)

www.eei.org

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Edison Electric Institute (EEI) is the association of United States shareholder-owned electric companies, international affiliates and industry associates worldwide. Organized in 1933, EEI works closely with its members, representing their interests and advocating equitable policies in legislative and regulatory arenas, including those related to interconnection and net-metering.

Electricité de France

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EDF has developed an international strategy based on investment and the sale of services. Renewable energies provides about 15% of France's electricity generation. Most of the output (93%) comes from the 500 hydro power plants (installed capacity 23,300 MW). They have generated 69 billion kWh in 1999. EDF is also involved in the development of solar and wind power. For instance, EDF is taking an active part in the Eole 2005 program, which aims at developing a truly competitive wind power industry in France with a generating capacity of 250 to 500 MW by 2005. Abroad, EDF has participated in the construction of a 50 MW wind farm at Koudia al Baïda, Morocco.

Electric Power Research Institute (California)

www.epri.com

Dr. Terry Peterson

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EPRI, the Electric Power Research Institute, headquartered in Palo Alto was established in 1973 as a center for public interest energy and environmental research. EPRI's collaborative science and technology development program now spans nearly every area of power generation, delivery and use. More than 1000 energy organizations and public institutions in 40 countries draw on EPRI's global network of technical and business expertise. For information about EPRI's programs, visit the EPRI Destinations website at www.epri.com/destinations.

Elektrizitätswerk der Stadt Zürich (ewz) (Switzerland)

www.ewz.ch

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By the end of 2002, EWZ, the electric utility of Zurich, Switzerland, will be producing power from 70 photovoltaic plants, located on both commercial as well as residential buildings, with a capacity of 2.5 megawatts. EWZ considers itself an innovative pioneer in energy, especially as a leader in promoting environmentally friendly power production. For more than 100 years, ewz has been supplying the town of Zurich and its citizens with electricity.

First Energy (New Jersey)

www.firstenergycorp.com

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First Energy, formerly known as GPU Energy, is part owner of a joint venture (GPU Solar) that develops, owns and operates solar electric power plants in the United States. GPU Solar operates two IPP solar plants in Northern California. First Energy has also partnered in New Jersey with the Liberty Science Center to develop educational displays and in-school presentations on solar and other renewable energy technologies.

Florida Municipal Power Agency

www.fmpa.com

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Florida Municipal Power Agency (FMPA) is a nonprofit, joint action agency formed by 29 municipal electric utilities. FMPA is a public agency, whose primary purpose is to develop competitive power supply and related services.

Georgia Power Company

www.georgiapower.com

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Gulf Power Company (Florida)

www.gulfpower.com

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As a Southern Company family member, Gulf Power participates in the EarthCents Solar program. Customers can pay an additional fee per month to purchase renewable energy that will displace other types of generation on the Southern Company grid. Gulf Power's Schools for Solar program is a program that uses voluntary contributions to fund material for energy education, permanent demonstration displays, savings bonds for science contest and teacher education. Voluntary contributions are solicited from customers interested in renewable energy and/or helping to improve the quality of Gulf Power Company service area schools.

Hawaii Electric Light Company, Inc.

www.hei.com

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Hawaii Electric Light Company continues to generate power from a variety of renewable resources including geothermal, run of the river hydro, wind, and solar. The company is the team leader for the Island of Hawaii's Million Solar Roofs Partnership and has conducted workshops on financing and installing solar systems. Over 2800 solar water heating systems installed under the company's Sun Power for Schools program. With the recent installation of a 5.4kW grid-connected PV system as an example of net metering, the company continues to promote the local adoption of solar technologies.

Indianapolis Power & Light Company (Indiana)

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JEA (Florida)

www.jea.com

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JEA, the public utility for the greater Jacksonville, Florida area, has become the largest user of grid-tied photovoltaics in the state, with 165 kWp installed to date in 32 systems. Each public high school in its service area has received at least a 4 kW system, along with teaching curriculum, laboratory kits and teacher training. Arrays at the Ridenour Water Treatment Station, Joyner Nature Preserve and Tree Hill Nature Center bring attention to elementary school students. Work continues in developing training programs for technician and building inspectors as well as creating an alternative energy laboratory at the University of North Florida.

Long Island Power Authority (New York)

www.lipower.org/solar

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Long Island Power Authority's Solar Pioneer Program helps its customer install solar through a combination of utility and state activities. This includes direct incentives of \$6 per watt, saving approximately 60% on system costs; low-interest financing; the New York State 25% tax

credit towards the total cost of a PV system; and net metering that allows homeowners to use excess energy produced by their solar electric systems to run their LIPA meters backwards.

Los Angeles Department of Water & Power (California)

www.greenla.com

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Los Angeles Department of Water & Power is constructing and operating solar photovoltaic systems on its facilities and municipal buildings throughout the city of Los Angeles. Libraries, community centers, municipal office buildings and multipurpose buildings will receive solar photovoltaic systems under this program. LADWP also has significant incentive programs for residential and commercial customers and additional incentives for manufacturers to locate plants with Los Angeles city limits.

Madison Gas & Electric Company (Wisconsin)

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Fax: 608.252.4734

Email: lwilliams@mge.com

Madison Gas & Electric (MGE) owns and operates three PV systems, for a total of 14.2 kW, to study their economic benefits and technical performance. In addition, the MGE Foundation has funded photovoltaic installations on all ten high schools in its electric service area and installed monitoring equipment to allow students to keep track of energy output and weather information on MGE's website. Teachers, school district staff, MGE and the Wisconsin K-12 Energy Education Program (KEEP) staff are crating educational materials and teacher training to make the most out of this learning opportunity.

Maui Electric Company (Hawaii)

www.hei.com

Ms. Joanne Ide
Phone: 808.871.2397
Fax: 808.872.3259

Email: jide@hei.com

Maui Electric Company continues to initiate and support many renewable energy projects. MECO has operated and maintained a grid-connected Photovoltaic for Utility Scale Applications facility since 1989. In a joint partnership with NOAA and NREL, MECO increased the size of an existing PV system at the Humpback Whale National Marine Sanctuary and signed it as the company's first net energy-metering customer. Through MECO's Residential Efficient Water Heating Program, over 3,300 solar water heaters have been installed since 1996. Five public high schools in MECO's territory have solar electric systems operating on their campuses providing a hands-on exposure to photovoltaic technology.

National Rural Electric Cooperative Association (Virginia)

www.nreca.org

Mr. John Holt
Phone: 703.907.5805
Fax: 703.907.5517

Email: john.holt@nreca.org

The National Rural Electric Cooperative Association (NRECA) is the national service organization dedicated to representing the national interests of consumer-owned rural cooperative electric utilities and the rural consumers they serve. NRECA's Cooperative Research Network performs collaborative research, development, demonstration and implementation of advanced technologies, means, methods and information to position electric cooperatives to thrive in a competitive market.

New York Power Authority

www.nypa.gov

Mr. Shalom Zeligher
Phone: 914.287.3824
Fax: 914.681.6860

Email: shalom.zeligher@nypa.gov

NYPA has 19 photovoltaic (PV) projects under its belt thus far, with a total of 576 kW of installed capacity. These include one of the world's largest rooftop PV systems (300 kilowatts) at New York City Transit's Gun Hill Bus Depot in the Bronx.

Northeast Utilities System (Connecticut)

www.nu.com

Mr. Roger J. Gibson
Phone: 860.665.3326

Email: gibsojrj@nu.com

Northeast Utilities and its subsidiaries are encouraging customers to use photovoltaics. One subsidiary, Western Massachusetts Electric Company (WMECO), is encouraging customers to try solar by offering photovoltaic systems at half the normal retail price.

Northern California Power Agency

www.ncpa.com

Mr. John Berlin
Phone: 916.781.4272
Fax: 916.783.7693

Email: jberlin@ncpa.com

Northern California Power Agency (NCPA) is a California joint powers agency with 15 publicly owned utilities as members. Several of NCPA's members, including Alameda Power & Telecom, Palo Alto, Plumas-Sierra REC and Silicon Valley Power are direct members of SEPA and are active in the development and promotion of solar power and other renewables. Other NCPA members, such as Lodi, Redding and Roseville Electric, participate in SEPA though NCPA and are actively promoting PV. Roseville has a city park PV demonstration project of .5 kW and is developing municipal and school PV systems and a solar curriculum for students.

Northern Indiana Public Service Company

www.nipsco.com

Mr. Arthur E. Smith
Phone: 219.647.5252
Fax: 219.647.5271

Email: aesmith@nisource.com

Northwest Rural Public Power District (Nebraska)

www.nrppd.com

Mr. Rolland Skinner
Phone: 308.638.4491
Fax: 308.638.4448

Email: rskinner@nrppd.com

Northwest Rural Public Power District (Northwest) installed its first PV system in 1990—a 100-watt system to power a livestock water pump. Since then, Northwest has installed 30 more off-grid PV systems. In 2002, it installed its first grid-connected system.

Nuon (Netherlands)

www.nuon.com

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Fax: +31.26.844.2186

Email: annemarie.goedmakers@nuon.com

Nuon is a prominent, independent, multinational oriented enterprise in the marketing and distribution of energy and water and related products. Nuon is one of the biggest investors in photovoltaic solar energy in the world, with expenditures in 2002 of greater than 30 million euros (approximately US\$27 million). Nuon has more than 500 solar power plants in the Netherlands with a total capacity of more than five megawatts supplying electricity to its "green energy" customers. In the U.S., Nuon owns and operates PV USA, located in Davis, California and is developing a new solar site under its partnership with Green Mountain Energy.

City of Palo Alto Electric Utility (California)

www.city.palo-alto.ca.us

Ms. Lindsay Joye
Phone: 650.329.2680
Fax: 650.617.3140

City of Palo Alto Utility's PV Partners Program is a program that offers incentives to its residents and businesses to make the installation of PV more affordable. Over 43 PV systems are installed in Palo Alto for a total of 143kW. Five sites have PV monitoring systems, which track the performance of PV systems on three residences, one office building and one high school. That data can be viewed at www.cpa.com/programs/pv-partners/pvdata.html.

Plumas-Sierra Rural Electric Cooperative (California)

www.psrec.org

Ms. Nell Thomas
Phone: 530.832.4261
Fax: 530.832.5761

Email: nell@psin.com

Plumas-Sierra Rural Electric Cooperative offers leasing of PV equipment to residential

customers. Participants pay a monthly customer charge for operation and maintenance costs. The lease period is fifteen to twenty years.

Public Service Company of New Mexico

www.pnm.com

Ms. Toni Ristau
Phone: 505.241.2015
Fax: 505.241.2340

Email: tristau@pnm.com

Public Service Company of New Mexico (PNM) formed an Enchantment Energy Trust in 1997, when PNM shareholders provided \$100,000 in seed money for alternative energy demonstration projects. An Advisory Group, made up of New Mexican experts in renewable energy, conservation, and environmental issues, was formed to assist PNM in selecting recipient sites and technologies for demonstration. The Trust has funded a number of PV projects, including the installation of a system on the Albuquerque Astronomical Society's General Nathan Twining Observatory.

Sacramento Municipal Utility District (California)

www.smud.com

Mr. Paul J. Bender
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Fax: 916.732.6563

Email: pbender@smud.org

SMUD has played a leadership role in the photovoltaics industry since the 1980's, when it began installation of mega-scale solar arrays. SMUD has active programs for its customers in virtually all market segments, including residential retrofit and new construction, commercial customers, community sites, and covered parking structures. To date, more than eight hundred solar electric hundred solar electric systems totaling over 10 megawatts of PV have been installed, providing clean power for thousands of customers in the greater Sacramento area.

Salt River Project (Arizona)

www.srpnet.com

Ms. Herjinder Hawkins
Phone: 602.236.2045
Fax: 602.236.3407

Email: hkhawkins@srpnet.com

Salt River Project (SRP) provides its customers with renewable energy through its EarthWise Energy program. SRP will have an installed photovoltaic power capacity of 1000, kW operational on the SRP grid by the end of calendar year 2003. SRP is involved in the testing and evaluation of small photovoltaic power systems, less than 5 kW each, for residential, school and commercial building applications.

San Francisco Public Utilities Commission (California)

www.sfwater.org

Mr. William G. Peden
Phone: 415.554.3468
Fax: 415.554.3161

Email: wpeden@sfwater.org

In November 2001, San Francisco voters approved the issuance of a \$100 million revenue bond to install 10 megawatts of solar and 30 megawatts of wind power to supply about 25 percent of the city government's energy. In February 2002, San Francisco released an RFP for help with its first installation, which will be a 400kW system on the Moscone Convention Center. The Moscone project will include an educational kiosk and building energy efficiency retrofits.

Silicon Valley Power (California)

www.siliconvalleypower.com

Ms. Leslie Brown
Phone: 408.615.5687
Fax: 408.244.2990

Email: lbrown@siliconvalleypower.com

Silicon Valley Power (SVP) is a department of the City of Santa Clara, serving over 100,000 residents (40,000 customers) and, 6,000 businesses in the heart of Silicon Valley. Silicon Valley Power has a program called Neighborhood Solar Program, through this program, customers can pay \$5 or more per month on their electric bill toward the construction of solar electric systems at community, non-profit facilities.

Socorro Electric Cooperative (New Mexico)

www.socorroelectric.com

Mr. Guadalupe Vega
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Fax: 505.835.4449

Email: lupe@sorroelectric.com

Soluz, Inc. (Massachusetts)

www.SoluzUSA.com

Mr. Richard d. Hansen
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Fax: 978.251.5291

Email: rhansen@igc.org

Soluz, Inc. is a business and technology development company that since 1993 has been developing the commercial potential of distributed micropower technologies as a source of electricity for rural areas of developing countries. Soluz has been demonstrating its business model for rural energy delivery directly through its majority-owned operations in Central America and the Caribbean. Through two operations serving thousands of rural customers by early 2002, Soluz has accumulated unparalleled experience with full-cost PV system rental, along with cash and credit sales. Soluz also participates in commercial efforts globally, including through its consulting arm, Global Transition Consulting.

Southern Company Services, Inc. (Alabama)

www.southernco.com

Mr. Randall Kyle
Phone: 205.992.6893
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Email: rlkyle@southernco.com

The Southern Company family of companies offers customers the opportunity to participate in the EarthCents Solar program. Customers can pay an additional fee per month to purchase renewable energy that will displace other types of generation on the Southern Company grid.

Springer Electric Cooperative (New Mexico)

www.springercoop.com

Mr. David E. Spradlin
Phone: 505.483.2421
Fax: 505.483.2692

Email: dfsprad@springercoop.com

Springer installed its first PV system in 1994. Since that time, Springer has installed around forty off-grid systems and one grid connected system. Springer offer customers both purchase and lease options in addition to a maintenance option for purchased systems.

Sun Power Electric (Massachusetts)

www.sunpower.org

Mr. Stephen Cowell
Phone: 508.836.9500
Fax: 508.836.3138

Email: steve.cowell@csgrp.com

Sun Power Electric was formed in 1996 by Conservation Services Group (CSG), an energy services provider working nationally, regionally, and locally to advance energy efficiency and renewable energy services as viable economic strategies. Since 1984 CSG has implemented energy efficiency and recycling programs for large utilities in New England, the mid-west and southwest. Sun Power Electric is the first all solar utility. Sun Power Electric has been installing 15 to 50-kilowatt sized PV systems on roofs of commercial buildings. The building owners receive the solar electricity and Sun Power Electric sells the "green attributes" in the market to retail electric providers.

Tallahassee Electric Department (Florida)

www.talgov.com

Mr. Orbra Harrell
Phone: 850.891.8230
Fax: 850.891.8277

Email: harrello@talgov.com

The City of Tallahassee recently installed a 10 kW PV system at the Trousdell Gymnastic and Aquatic Center. The PV System is grid connected, providing power for general distribution to the rest of Tallahassee when not being used at the Aquatic Center. The city also has an 18kW system at the Capital Center Office Complex.

Tennessee Valley Authority

www.tva.gov

Ms. Rita Livezey
Phone: 423.751.8027
Fax: 423.751.6087

Email: rjlivezey@tva.gov

By including solar power in Green Power Switch, a green power program, TVA both enhances the environment and promotes the increased use of PV. All 11 solar sites planned as part of the first phase of renewable generation for Green Power Switch are operational, providing 250 kilowatts of solar-powered electricity for the Tennessee Valley.

Tucson Electric Power Company (Arizona)www.tucsonelectric.com

Mr. Bill Henry
 Phone: 520.745.3251
 Fax: 520-884-3934
 Email: bhenry@tucsonelectric.com

Tucson Electric Power Company's (TEP) combined solar operations, which includes 315 kW in Tucson and a 1.4 MW installation at its Springerville Generating Station, are now able to provide enough green power to meet the energy needs of approximately 200 residential customers. TEP has announced that it will be increasing the Springerville system to 2.4 MW of generating capacity in 2002.

TXU (Texas)www.txu.com

Mr. William E. Muston
 Phone: 214.812.8407
 Fax: 214.812.8967
 Email: bill.muston@txu.com

Vectren Corporation (Indiana)www.vectren.com

Mr. Norm Campbell
 Phone: 812.491.4883
 Fax: 812.491.4777
 Email: ncampbell@vectren.com

We Energies (Wisconsin)www.we-energies.com

Mr. Carl Siegrist
 Phone: 414.221.2183
 Fax: 414.221.3990
 Email: Carl.Siegrist@we-energies.com
 We Energies is the trade name of Wisconsin Electric Power Company and Wisconsin Gas Company, the principal utility subsidiaries of Wisconsin Energy Corporation. We Energies serves more than one million electric customers and more than 970,000 natural gas customers throughout Wisconsin and Michigan's Upper Peninsula. Our Energy for Tomorrow® renewable energy green pricing program is rated as one of the nation's "top 10" programs by the DOE's National Renewable Energy Lab. Our commitment to having at least 5 percent of our retail electricity sales generated from renewable energy sources (including solar PV, wind, biomass, and small hydro) by 2011 significantly exceeds what is required by law.

Western Area Power Administration (Colorado)www.es.wapa.gov

Mr. Randy Manion
 Phone: 720.962.7423
 Fax: 602.352.2630
 Email: manion@wapa.gov

Western Area Power Administration (Western) markets and delivers about 10,000 megawatts of power from 55-hydropower plants to more than 650 utilities across a 15-state service territory. Western's mission is to market and deliver reliable, cost-based hydroelectric power and related services

Westerville Electric Division (Ohio)www.ci.westerville.oh.us

Mr. Andrew Boatright
 Phone: 614901.6703
 Fax: 614.901.6731

Email: aboatright@ci.westerville.oh.us

The City of Westerville Electric Division (WED) has been actively involved in energy education initiatives through its financial and in-kind support of the Ohio Energy Project. The Ohio Energy Project educates students on all forms and types of energy. Energy educated activities in Westerville City schools have increased dramatically since the City's donation of the first Energy Bike in 1998. Since that time, four new Energy Bikes have been donated and "Kids Teaching Kids" energy workshops have significantly increased in frequency throughout the district.

Wisconsin Public Service Corporationwww.wisconsinpublicservice.com

Mr. Jeffrey L. DeLaune
 Phone: 920.433.1722
 Fax: 920.433.1527
 Email: jdeLaun@wpsr.com

Solarwise for Schools is a solar energy and education program offered to high schools served by Wisconsin Public Service Corporation. There are currently fifteen high schools in the Wisconsin Public Service area which have SolarWise systems installed. Wisconsin Public Service Corporation is also assisting the University of Wisconsin-Green Bay in integrating

23 kilowatts of building integrated photovoltaics (BIPV) into a new 120,000 square foot classroom building on its campus. In 1993, Wisconsin Public Service installed a 12-kilowatt solar power plant at its Green Bay service center.

PV MANUFACTURERS, DISTRIBUTORS, AND INSTALLERS**ABS Alaskan (Alaska)**www.absak.com

Ms. Dalanda Eppley
 Phone: 907.562.4949
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 Email: dalanda@absak.com
 Founded in 1988, ABS Alaskan, Inc. and its Anchorage subsidiary, Alaska Battery Mfg., are a major source in Alaska for batteries, alternative energy and remote or mobile power products.

Altair Energy, an Alpha Group Company (Colorado)www.alpha.com

Mr. Kirk Stokes
 Phone: 303.277.0025
 Fax: 303.277.0029
 Email: kstokes@alpha.com
 Altair Energy, Inc is an established, value-added integrator of photovoltaic and other distributed generation (DG) power systems for residential, small commercial and institutional applications. The company has emerged as a technology market innovator, helping manufactures, electric utilities and other organizations to take a leadership role in the growing DG industry. With manufacturing, sales and distribution support from Alpha Technologies, a worldwide leader in cable TV and telecommunications industries. Altair's state of the art photovoltaics (PV) systems makes it easier for homeowners and businesses to enjoy clean reliable, solar electricity. Altair's full service approach to PV makes it easy for anyone to convert sunshine into free solar electricity.

Alten Energy (California)www.altenenergy.com

Mr. Avi Alcala
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 Email: avi@altenenergy.com

Amonix, Inc. (California)www.amonix.com

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 Amonix, Inc. is a privately held designer and manufacturer of proprietary, patented high-performance photovoltaic solar cells and integrated high-concentration PV (IHCPV) solar generating systems that convert sunlight to electricity. Amonix's IHCPV systems are ideal for centralized "solar farm" power applications or for distributed applications including village electrification. IHCPV technology is a non-polluting, efficient and reliable power source for the future.

ASE Americas, Inc. (Massachusetts)www.asepv.com

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 Email: thunton@asepv.com
 Over 25 years of research and development at ASE has resulted in clean, powerful, and high quality solar wafers cells and modules. ASE's products provide decades of clean, reliable electricity for businesses, homes, energy service providers, and many other applications. ASE belongs to the RWE Solutions group, a supplier of integrated technical systems and services (multi-utility services) focusing on the energy sector.

AstroPower, Inc. (Delaware)www.astropower.com

Mr. Howard J. Wenger
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 Email: hwenger@astropower.com
 Headquartered in Newark, Delaware, AstroPower is the world's largest independent manufacturer of solar electric power products, and one of the fastest-growing solar electric power companies. Through partnerships with

the world's largest home improvement retailer, the nation's leading homebuilders, and an expansive dealer network, AstroPower is giving consumers everything they need to produce their own clean, renewable electricity at home. AstroPower's SunChoice™ solar electric home power systems are designed to provide years of automatic operation, and include AstroPower modules, plug-and-play wiring, power electronics, patented mounting kits, a power meter to monitor performance, and complete documentation.

BP Solar (Maryland)www.bpsolar.com

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 BP Solar and its extensive network of distributors and dealers provide total solar electric power solutions for industrial, commercial, and residential customers throughout the world. BP Solar has a full range of high efficiency crystalline and thin film photovoltaic modules and products ranging from small DC lighting and pumping systems to large AC grid-intertied commercial power plants.

Bass Renewable Energy Resources (California)www.bassrer.com

Mr. Jeffrey Yee
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 Fax: 415.642.4335
 Email: jeffrey@bassrer.com

EcoEnergies (California)www.ecoenergies.com

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 EcoEnergies was incorporated in 2000 to create a quality-oriented company that designs, constructs, delivers and maintains renewable energy power systems and related energy efficiency products using wind, solar, small hydro and other "green power" and energy efficiency technologies. Located in the heart of the Silicon Valley in Sunnyvale, California, EcoEnergies is a renewable energy systems and integration company that designs, specifies and installs renewable energy power systems for its clients.

Evergreen Solar, Inc. (Massachusetts)www.evergreensolar.com

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 Evergreen Solar, Inc. develops, manufactures, and markets solar power products utilizing the company's patented solar power technologies. Evergreen Solar power applications include wireless power for remote homes, water pumping, lighting, and rural electrification, as well as complete power systems for electric utility customers choosing to generate their own environmentally benign green power.

First Solar, LLC (Ohio)www.firstsolar.com

Mr. Mike Ahearn
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 First Solar manufactures high quality, thin film CdTe Photovoltaics modules at its plant in Perrysburg, Ohio. Corporate and marketing offices are located in Phoenix, Arizona.

Global Solar Energy (Arizona)www.globalsolar.com

Mr. Scott L. Kaminky
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 Global Solar Energy, Inc is a manufacturer of thin-film Copper-Indium-Gallium-diSelenide (CIGS) photovoltaic (PV) cells, modules and systems. Global Solar also designs, installs, commissions and services complete turnkey solar PV power stations utilizing various commercially available PV module technologies, including one of the worlds largest grid-tied systems at 2.4 MW in Springerville, Arizona.

ICP Global Technologies (Québec, Canada)www.icpglobal.com

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ICP Global Technologies develops manufactures and markets advanced solar powered monocrystalline and amorphous products for the following consumer channels: distributed residential, portable and mobile (www.isunpower.com) throughout the 5 continents. The company's enabling technology converts raw power from the sun into high-quality power required by electronic and electrical equipment.

Inter-Island Solar Supply (Hawaii)www.solarsupply.com

Mr. Cully Judd
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 Fax: 808.536.5586
 Email: cjudd@solarsupply.com
 Inter-Island Solar Supply (ISS) is one of the nation's largest distributors of renewable energy products and packaged systems. ISS is also a supplier of water heaters and storage tanks, pumps, controls, solar attic fans and skylights. The company's three Hawaii branches are conveniently located in Honolulu (Oahu), Kahului (Maui) and Kailua-Kona (Big Island).

Kyocera Solar (Arizona)www.kyocerasolar.com

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 Kyocera is a manufacturer and distributor of solar electric products. Kyocera Solar, Inc. has headquarters in Scottsdale, Arizona, and sales affiliates in the Americas and Australia. Kyocera's advanced cell-processing technology and automated production facilities produce highly efficient multicrystal photovoltaic modules with a 25 year limited warranty on power output. These modules are installed on the roofs of thousands of grid-connected homes, not only producing electricity for households but also allowing surplus to be sold back to the utility.

Multi-Contact USA (Pennsylvania)www.multi-contact-usa.com

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 Multi-Contact USA is the United States subsidiary of Multi-Contact AG, a manufacturer of precision electrical and electronic connectors. The company's products range from miniature PCB connectors to large power connectors. These products are used in power generation and distribution, signal and data processing, medical and monitoring instruments. Multi-Contact connectors are found in supercomputers, robotic docking systems, high speed trains, Photovoltaics and many other applications.

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Pacific Solar Pty. Limited (Australia)www.pacificsolar.com.au

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 Pacific Solar is a high-tech spin-off company from the University of New South Wales in Sydney, Australia. Pacific Solar spans the range from research and development through marketing and sales of PV systems as part of its operations which are certified to the international quality standard ISO 9001. Pacific Solar's main product is the world's first completely modular rooftop system designed as an appliance for mounting flat over roofs, called Plug & Power™ in Australia and Europe and SunEmpower™ in the USA.

Phasor Energy Company (Arizona)www.phasor.com

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 PhasorEnergy Company, Inc. was established in 1994 to promote the wise use of energy. Phasor currently specializes in innovative applications of photovoltaic technologies. The company offers a range of engineering and consulting services encompassing the entire life span of a project from conceptual planning,

through design and engineering, project management, installation, startup testing, data collection, analysis, performance evaluation and reporting. Phasor also designs/builds PV projects of any size.

PowerLight Corporation (California)

www.powerlight.com

Mr. Daniel S. Shugar
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PowerLight Corporation is a designer, manufacturer and installer of grid-connected, commercial solar electric products and systems. Founded in 1991, PowerLight's products deliver reliable, affordable, clean power for commercial customers throughout the US and worldwide. In 2000, INC. Magazine ranked PowerLight among the top 200 fastest growing privately held companies in the US.

ProVision Technologies (Hawaii)

www.provisiontechnologies.com

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Email: sburns@hei.com

ProVision Technologies, Inc., the newest member of the Hawaiian Electric Industries (HEI) companies, provides solar electric design, products and services for Hawaii and the Asia-Pacific region. Based in Hilo on the island of Hawaii, Provision Technologies markets solar electric systems that provide power to individual households, commercial facilities and the community at large. Some of the standardized energy generation products that ProVision Technologies offers include solar electric systems to power remote homes or facilities, grid-tied residential and commercial systems, building-integrated systems, portable solar power systems and solar lighting. Additional services include financing assistance, maintenance services, training and program consultation.

RWE Schott Solar (California)

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RWE Schott Solar is a photovoltaic distributor and complete systems provider. SAPC and its partners bring clean energy to businesses, utilities homeowners and governments worldwide.

SMA America (California)

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SatCon Power Systems (Canada)

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Solar Design Associates (Massachusetts)

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Solar Design Associates (SDA) is a group of architects and engineers dedicated to the design of sustainable buildings and the engineering and integration of renewable energy systems that incorporate the latest in innovative technology. Since its founding in 1974, the firm has earned an international reputation for the pioneering integration of renewable energy - especially solar-generated electricity - with environmentally responsive building design. The firm offers a wide diversity of services to private, commercial, research, and utility clients.

Solec International, Inc. (California)

www.solecsolar.com

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In 1994, Solec combined forces with Sanyo Electric in Japan. Both companies share a commitment to excellence and are making strides toward improvements in the solar energy industry. Solec is a pioneer in developing major

improvements in crystalline silicon photovoltaic. In 1997, SANYO introduced new PV cells and modules called HIT Power 21™ (Heterojunction with Intrinsic Thin Layer). HIT systems power lighting systems worldwide, as well as thousands of highway emergency call boxes, road signs, and traffic signals.

Southwest PV Systems (Texas)

www.southwestpv.com

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Email: swpv@southwestpv.com

Spire Corporation (Massachusetts)

www.spirecorp.com

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Fax: 781.275.7470

Email: shogan@spirecorp.com

Spire, founded in 1969, is the world's largest supplier of PV module manufacturing equipment, to date supplying over 144 facilities in 42 countries. Approximately 90% of PV modules in use today were manufactured in part with Spire equipment. Recently, Spire has taken a leadership role in partnership with other organizations to formulate an innovative approach addressing the development of brownfields into brightfields, through the establishment of on-site PV manufacturing and power-producing facilities. Through this concept, Spire promotes the use of clean energy, revitalizes brownfields, and contributes to new local job creation.



SunWize Technologies (Illinois)

www.SunWize.com

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SunWize Technologies specializes in the design and manufacture of integrated solar power systems, project development and product distribution. SunWize's capabilities include value-added system integration and utility grid-tied systems. The company works with customers in many industries including telecommunications, traffic safety, oil and gas, utilities, state and federal government agencies, and the military. Customers are serviced from SunWize's 30,000 sq. foot manufacturing and distribution facility in New York State and an 8,500 sq. foot distribution center in California. Regional sales offices are located in Arizona, California, Colorado, Illinois, Maryland, Montana, New Mexico, Texas, and Washington. SunWize established the Solar Connect® residential grid-tied programs where homeowners are serviced through a national dealer network. Qualified Solar Connect installers assist homeowners in choosing the appropriate system for their power requirements and help with information concerning net metering and State and Federal renewable energy incentives. SunWize also provides products and construction management services for commercial grid-tied applications. Through strategic partners, SunWize collaborates with finance specialists to make funding available to homeowners, commercial businesses, and government entities.

Products range from the 10-watt SunWize Portable Energy System for charging satellite telephones to a custom-engineered 2400-watt SunWize Power Station that provides utility-grade electricity for industrial and residential applications. SunWize's product line includes the PowerPort, a 30kW system designed for grid interactive PV applications. All products are factory-tested and meet NEC standards. SunWize also develops custom-engineered solar modules for integrating solar power into OEM battery-operated products.

UniRac (New Mexico)

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UniRac manufactures a comprehensive line of photovoltaic module mounting racks. SolarMount standard and HD (heavy-duty) extruded aluminum rails promote solid,

installation-friendly arrays for a variety of racks: large arrays (ground or commercial roofs), residential roof mounts, ground mounts, and large pole mounts. Passive trackers, side-of-pole, and RV mount models are also available. UniRac products accommodate any framed PV module and employ aluminum and/or Grade 5 zinc plated steel. All fasteners are stainless steel. Products are shippable via UPS. Design and code-compliance issues addressed.

Uni-Solar (U.S.A)

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Uni-Solar is a leading manufacturing and marketer of thin-film, building integrated photovoltaic (BIPV) solutions designed for commercial/industrial, residential markets and consumer markets. Uni-Solar's award-winning products are durable, lightweight and simple to install. In addition to producing more energy than traditional crystalline solar energy solutions, Uni-Solar's amorphous silicon products are flexible-making them ideal for all roofing situations and conditions. Uni-Solar is market-driver and the preferred supplier of solar energy systems, worldwide.

Xantrex Technology (British Columbia, Canada)

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Xantrex Technologies, which acquired Trace Engineering in 2000, is a world leader in advanced power electronics. Our technology is a key enabler for renewable energy systems, efficiently converting raw electrical energy from any source such as solar, wind, or microhydro, into high-quality household power. More than 200,000 homes and businesses rely on Xantrex power electronics to bring them electricity anytime, anywhere. Xantrex products allow customers around the world to increase energy efficiency and freedom, while making a positive impact on the environment.

PV STAKEHOLDERS

Applied Energy Group, Inc. (Delaware)

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Navigant Consulting, Inc (Massachusetts)

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Navigant Consulting, Inc., (NCI) is a publicly traded consulting firm with over 1,100 consultants in 40 offices. Our renewable and distributed energy (RDE) business has strong expertise in photovoltaics and concentrating solar power. Utility and energy companies,

equipment manufactures, investors and developers, energy end users, and government agencies are turning NCI to help them understand how to create value from RDE technologies and businesses. Whether we are providing a feasibility assessment a technology integration plan regulatory compliance studies, a business plan with recommendation, acquisition assistance, business partner support, or critical guidance on how to meet policy objectives, NCI brings rich technology and industry experience, know-how and people.

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The NCSU Solar Center serves as a clearinghouse for information, education, in-state technical assistance and applied research on solar and other renewable energy technologies. The Center is home to research and testing projects on emerging solar technologies including concentrating solar thermal technologies, building integrated photovoltaics, and solar pasteurization. The Center features a solar demonstration home that is used year-round for public education on active and passive residential solar systems. Other public outreach programs and services include in state workshops for building professionals and contractors, design reviews for home builders and educational programs for local K-12 schools. In addition, the Center manages the Database Incentives for Renewable Energy (DSIRE), available at www.dsireusa.org.

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Solar International Management, Inc a Washington DC- based management and financial consulting firm, specializes in corporate strategic planning in the renewable energy field, with exceptional expertise in the solar PV area. President Michael Eckhart is widely known around the world for financing of solar energy, and sponsorship of the SolarBank program. He also is acting Chairman of the American Council for Renewable Energy. Research Associate Jodi Roussell has global business research capabilities, providing clients with research support in all global markets. SIM advises corporate and institutional clients.

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Solar Electric Power Association

For further information on
SEPA members and programs,
visit the SEPA webpage at
www.SolarElectricPower.org.

SolarWise for Schools Keeps On Shining in Wisconsin

Wisconsin Public Service Company (WPS) leads one of the most aggressive and publicly supported solar school programs in the country, SolarWise for Schools. SolarWise for Schools currently has 32 schools participating through an educational program; 27 of these schools house solar electric systems. SolarWise for schools is a solar energy and education program offered to high schools served by Wisconsin Public Service Corporation.

In 1996, with funding from the TEAM-UP program, three high schools were the first to participate in this SolarWise for Schools. In the years since, approximately three schools per year have received solar electric systems. Seven other schools have received the renewable energy curriculum package through a grant from the Wisconsin Environmental Education Board. An added benefit of the program is that schools save money on their electricity bills,

freeing up funds for other critical services.

Over the next two years, solar electric systems will be installed on nine more schools in Wisconsin; they also will receive the SolarWise for Schools educational program. The Wisconsin Public Service Community Foundation, a nonprofit educational organization, is one vehicle for SolarWise funding. Approximately 5,000 WPS customers are contributing tax-deductible donations to the Foundation to support SolarWise. These funds—combined with grants from various organizations such as the State of Wisconsin Division of Energy, Wisconsin Environmental Education Board, and the State's Focus on Energy program—provide the resources to create the curriculum, purchase and install new solar electric systems, and maintain the existing systems.

Perhaps the most important component of SolarWise for



Local installers complete the roof-top solar electric system on Ashwaub High School as part of Wisconsin Public Service Company's SolarWise for Schools program.



The winning team of this year's seventh annual Solar Olympics, from Denmark High School, pose with their award. The Solar Olympics consists of 10 events testing student's knowledge of solar electricity.

Schools is the educational package on renewable energy that accompanies the solar electric installations or is distributed separately. The package includes three-week curriculum for high school students, a complete set of audiovisual materials, and laboratory equipment. Students at the schools with solar electric installations have the capability to monitor the system's daily energy output using the Internet. WPS holds workshops to train teachers with the renewable energy curriculum package.

SolarWise for Schools takes education a step beyond the classroom to the Solar Olympics.

The Solar Olympics is an annual, daylong fair and competition in which students from schools with the education packet participate. Students spend the months leading up to the Olympics designing and building a solar cooker, a solar hot water heater, a solar-powered car, and a solar sculpture. These creations are scored, along with a *Jeopardy*-style quiz and a solar essay, to determine the winning team. Since the first solar Olympics in 1996, the event has grown. The seventh annual Solar Olympics was held on May 5, 2003, and had a record participation with 14 teams competing and two teams

observing.

The WPS SolarWise for Schools program has been designed to take advantage of all the benefits a solar electric system provides a school. The community gets involved and has a sense of ownership through the Wisconsin Public Service Community Foundation; teachers are trained and learn about renewable energy; students have the opportunity to apply their knowledge in the Solar Olympics; schools save money on their electricity bill; and a new generation grows up with an understanding and appreciation for renewable energy.

Solar Power to the People: Photovoltaics is Put to a Vote

By Tara Willey

There have been a number of initiatives across the country putting renewable energy policy in the hands of the voters. Several solar and renewable energy campaigns have received national attention in the past few years, most notably Proposition B, the San Francisco Solar Bond.

Proposition B

The San Francisco, California, Solar Bond was put to a vote and passed in the fall of 2001. This action approved the sale of \$100 million in revenue bonds that will finance renewable energy projects. The long-term goal is to add 40 megawatts of solar power to the electricity grid and to implement energy-efficiency efforts. While the Solar Bond was approved a year and a half ago, it has faced a slow implementation. Despite the slow start, the Solar Bond has en-

joyed widespread public support.

Planning for the first solar electric system sponsored by Proposition B began in November 2002. In a ceremony that included commissioners from the San Francisco Public Utilities Commission and singer Bonnie Rait, San Francisco Mayor Willie L. Brown, Jr., announced that PowerLight had been awarded a contract to install 675 kilowatts of solar panels on the Moscone Center, a prominent meeting and exhibition facility.

Vote Solar

The Vote Solar Initiative made news in 2001 when it helped promote the campaign for Proposition B, the San Francisco Solar Bond. Since then it has continued to push for solar legislation.

Another effort that Vote Solar is undertaking is legislation for a \$100 million solar bond initiative, similar to the San Francisco model,



Singer Bonnie Rait, San Francisco Mayor Willie L. Brown, Jr., and others were in attendance at a ceremony announcing a contract with PowerLight to install a 675-kW solar electric system—shown here in an artist's rendering—at the Moscone convention center.

introduced in the state of Hawaii. The Hawaii bond is a step toward utilizing the state's solar resource and reducing its dependence on fuels shipped from the mainland, which contribute to Hawaii's high cost of electricity. Vote Solar continually provides information to other cities and municipalities to encourage the replication of San Francisco's activities.

Vote Solar also became involved in the "exit fee" debate in California earlier this year. Several California utilities had supported an exit fee on solar and other distributed generation sources; the California Public Utilities Commission, however, voted down the proposed exit fees.

Next Generation

A company that has worked closely with Vote Solar and that was critical to the success of the Proposition B/Vote Solar Campaign is Next Generation. Next Generation is a campaign consulting firm working to advance environmental issues. Proposition B was Next Generation's first solar energy campaign. More recently, Next Generation again joined forces with Vote Solar to oppose the California exit fee on solar and other distributed generation. Another Next Generation effort includes helping the California branch of the Solar Energy Industries Association to take a proactive approach to expanding solar through working with the California legislature.

These activities all indicate a growing public demand for renewable energy, and solar in particular. As people demand cleaner energy, organizations are stepping forward to coordinate and focus efforts to realize these demands. The tidal wave of public demand for green energy has grown large enough that utilities and businesses are taking notice and developing strategies to adapt their operations to include solar energy. While the solar movement of the past has been associated with a fringe group, today's movement encompasses a broad range of people, indicating that solar is here to stay.

Tara Willey is the Program Coordinator for the Solar Electric Power Association.



This view of the Moscone Center, the Zeum Childrens Museum, and the Loof Carousel illustrates the unique design of the facility, which will soon be home to a 675-kW solar electric system.

Solar Helps Power Arizona's Imperial National Wildlife Refuge

The Imperial National Wildlife Refuge, located north of Yuma, Arizona, along the Colorado River, unveiled a new 10-kW solar installation on the roof of its visitors center in January 2003. The system, designed and installed by American Solar Electric, Inc., incorporates 64 of Kyocera's KC-158G solar modules. This rooftop solar array will offset a high percentage of the grid-supplied power used by the visitors center and office complex, saving taxpayers money.

"American Solar did an excellent job with our installation," stated Ken Edwards, manager of the refuge. "We feel that we're doing the right thing by using the sun for renewable energy production. It's simply a wonderful addition to our visitors center."

The refuge also plans to help educate the public about the benefits of solar energy. This new solar array will become the focus of an educational tool to teach visitors how solar electric (photovoltaic) modules convert the sun's rays into clean, renewable energy. The visitors center receives more than 6,000 visitors per year; annually, over 2,600 children and adults participate in educational tours on the refuge's 26,768 acres.

"We are very proud to see our solar products powering a wildlife



The Imperial National Wildlife Refuge features a 10-kW solar electric installation, designed and installed by American Solar Electric, with modules from Kyocera.

refuge," said Doug Allday, President of Kyocera Solar, Inc. "This installation is an ideal fit with

Kyocera's corporate commitment to protecting the environment and improving people's quality of life."

Renewable Generation R&D Grows in Sacramento, California

REGEN, from page 5

uled for this year.

Flat Roof Mounting System

In one of their two ReGen projects, RWE Schott Solar has developed a new nonpenetrating, nonballasted mounting system for the flat rooftop market. The system features a tilted PV design that can handle wind speeds greater than 90 mph. The key challenge was inventing a design that had no roof penetrations and no ballasting, yet could withstand strong winds. The result of a great deal of creative thinking is a design that allows the PV panels to rest at an angle in still air. As wind speeds increase, the lower end of

the module rises, thereby reducing lift and allowing the array to stay firmly in place on the roof.

This system has undergone thorough wind tunnel testing to establish its safety. A demonstration project was completed in 2002 and it easily withstood the high winds of a large California winter storm. The system will soon be installed on a La-Z-Boy furniture store in Rancho Cordova, California.

Performance Indexing of Photovoltaic Systems

SMUD and Andy Rosenthal from Southwest Technology Development have developed an automated software system which will identify underperforming PV

systems in the SMUD service area. The software uses weather data and the characteristics of each system to calculate the expected energy production for the month. It then compares the result to the actual meter data from the PV installation. (All of the PV systems in SMUD's service area have separate electric meters.) Underperforming and nonperforming systems will be automatically flagged for maintenance.

For SMUD and other utilities with photovoltaic installations, this software will be an invaluable tool to ensure that the systems are operating properly. The software package is presently undergoing test runs.

Slat-Array Concentrator Development

SVV Technology Innovations is developing a new concept for concentrating solar power. The design features a slat-array concentrator. The goal of the project is to develop and test a prototype with good efficiency and the potential to reduce the installed cost of manufactured units.

SVV completed a software modeling package that was used to optimize the design of the first system, which is presently being assembled.

Non-Vacuum Thin-Film CIGS Modules

UniSun, the contractor for this project, is developing a process for manufacturing thin film PV without using negative atmospheric pressure (a vacuum). If manufac-

Solar for Polar Bears?

By Holly Riester

Well, not quite, but the polar bears at the Lake Superior Zoo in Duluth, Minnesota, will be a little more comfortable this summer, thanks to renewable energy. The zoo is going to be the site for the first Rebuild Minnesota renewable energy demonstration project, which includes several projects to provide energy and educational opportunities.

One of the projects at the zoo is a geothermal heat exchanger that will be used to cool the water in the polar bear and seal pools in the summer. The system will use the subsurface waters of a nearby stream and is expected to save 100,000 kWh of energy each year.

A different form of solar power will be used to heat water for the animal barn. A solar water heating system will be installed on the animal barn and is expected to supply 60 percent of the barn's daily hot water needs. The animal barn is part of the children's section of the zoo and provides an excellent educational opportunity.

Another project calls for the installation of photovoltaic panels to power an electric vehicle refueling station. The panels and the station will be displayed in such a way to provide an educational opportunity as well.

A fourth project being planned is a micro-hydroelectricity facility to be built on a creek on the zoo's property. The power generated from the creek will be used for an exhibit on Australia as well as the zoo's butterfly garden.

The Lake Superior Zoo program is the first demonstration project for Rebuild Minnesota, a program through the Minnesota

Department of Commerce and a part of the Rebuild America Program. Rebuild America is a technology-deployment program of the U.S. Department of Energy that focuses on saving energy through community-driven solutions. Rebuild America is a network of nearly 500 community partnerships made up of local governments, schools, universities, public and private businesses, and housing agencies dedicated to saving energy, improving building performance, reducing air pollution, and enhancing the quality of life through energy efficiency. The



partners on the zoo project include Minnesota Power, Lake Superior Zoo and Public Works and Utilities, Rebuild Minnesota Institute, Johnson Controls, and LHB architects and Engineers.

For more information about the Lake Superior, visit their webpage at www.lszoo.org.

Holly Riester is the Program Manager for the Solar Electric Power Association.

turing costs, one of the factors contributing to the high cost of PV, can be reduced, then the overall cost of the solar electric system will also come down. The cost of the equipment to manufacture thin film solar panels is high, but, by developing a manufacturing technique that does not require a vacuum, UniSun can significantly reduce the upfront cost of solar.

The technology holds a great deal of potential.

Mainstreaming Photovoltaics for Residential Roofs

PowerLight Corporation is coordinating one of several ReGen projects developing residential BIPV roofing products. The company is adapting its flat roof solar electric system for use on sloped roofs. Additionally, PowerLight is designing a new commercial flat roof product. The residential product will provide the same benefits as the flat roof systems: reduced roof deck temperatures, increased roof durability, reduced home cooling loads, and easy installation. While this project will utilize some of the same techniques as the company's other systems, PowerLight will make fundamental changes that may carry over to its commercial-sector products.

A 200-kW array is planned for Los Angeles, California, to test the flat roof product, and a 4-kW array is planned for the SMUD service area to test the sloped roof

BIPV product.

Accelerated Anaerobic Digestion for Energy Generation

This biomass project is located at the Yolo County Landfill. Yolo County is producing landfill gas earlier, faster, and in greater quantities by adding water to the landfill. As a result, energy production is expected to be less expensive. Other possible benefits for the project include: improved quality of leachate, reduced risk of groundwater contamination, reduction of waste volume, extended lifespan for the disposal site, and reduced greenhouse gas emissions. This project has substantial funding from other sources, including Yolo County itself.

The installation is almost complete and extensive monitoring will verify the method. Preliminary data shows excellent results.

Although only a selection of the ReGen projects are discussed here, all are producing valuable results. For more information on the ReGen program please visit www.SMUD.org/pier. For more information on the PIER program, please visit www.energy.ca.gov/pier.

Bruce Vincent is the project manager for the ReGen program and Senior Demand Side Specialist at the Sacramento Municipal Utility District.



Yolo County landfill is the test site for a new method of anaerobic decomposition to accelerate the production of methane for fuel. This project is funded by SMUD's ReGen program.

Solar Grows Along With City of Palmdale

One of the fastest growing cities in the United States, Palmdale, Calif., is turning to the sun for energy. Located in southern California, 60 miles from Los Angeles, Palmdale has an incredible solar resource. As of January this year, the Palmdale Water District began using this resource to reduce its dependence on the local electric utility. RWE Schott Solar installed a 30-kW solar electric system on the roof of the District's shop building.

The State of California will provide up to half of the cost of the solar electric system through a rebate program to encourage distributed generation. In addition to harnessing the sun's power, the water district is planning to capture power from the wind using a large turbine. The wind turbine will be located near the city's water treatment plant. Black and Veatch contracted to help with the siting of both renewable energy projects.



RWE Schott Applied Power completes the installation of the 30-kW solar electric system on Palmdale Water District's shop building.

Solar Café: Good Food, Good for the Environment

Two SEPA members are helping to turn an old railroad station into a model of smart growth and sustainability. The Brentwood Railroad Station in Brentwood, New York, is being remodeled to accommodate the Fiesta Solar Café, and the Long Island Power Authority (LIPA) and Kyocera are big contributors. The final plans for the Fiesta Solar Café include one Kyocera solar electric power system on the roof and another on a parking structure. Through its Solar Pioneer program, LIPA is providing a rebate for the solar electric system, covering approximately half of the cost.

The café is an example of a growing movement to curb sprawl and revitalize aging neighborhoods while preserving historic buildings. The principle behind the movement is to improve the quality of life for everyone by reducing traffic, encouraging growth of small businesses, and strengthening communities. Smart growth often goes hand-in-hand with an environ-

mental consciousness. By redeveloping existing urban areas, cities don't need to expand and sprawl is discouraged. Thus, new land isn't cleared for development and commutes are kept at a minimum.

The Fiesta Solar Café utilizes green building techniques, including the incorporation of a solar electric system to supply all of its daytime energy needs. The café incorporates energy and water efficiency, sustainable materials, and other environmental building techniques to meet the U.S. Green Building Council's Leadership in Energy and Environmental Design voluntary certification standards.

It is fitting that Kyocera provide the solar electric system for the project; the company's management philosophy is "to coexist harmoniously with nature and society."

At the Fiesta Solar Café, customers dine on a menu of fresh products and healthy ingredients prepared with 100 percent solar power!



The Brentwood, N.Y., Railroad Station is being remodeled to accommodate the Fiesta Solar Café. A Kyocera solar electric power system was added to the roof and another to a parking structure.

Schools Going Solar in Detroit

By Holly Riester

Detroit Edison, a subsidiary of DTE Energy, has partnered with several commercial customers to sponsor solar educational programs for local schools. Elementary schools can become SolarSchools®, which includes receiving 1,500 watts of solar electric service through Detroit Edison's SolarCurrents® program as well as the educational portions of the program.

The educational components include a two-week curriculum on solar electricity and other forms of alternative energy. The curriculum includes a student workbook and many hands-on activities to help the students learn the technical elements involved in solar electricity, solar thermal energy, and other forms of renewable energy. The activities provide an inval-

uable opportunity for experiential learning to help elementary students fully understand some of the difficult concepts involved in solar power.

The curriculum is specifically designed not only to teach children about alternative energy sources, but also to pique their interest in science and improve their research and scientific skills. Students learn about conducting experiments; gathering, analyzing, and comparing data; taking measurements; and making calculations. In addition to these science skills, students also gain language arts skills, social studies skills, mathematical skills, and experience using technology as well.

Each school participating in the program receives copies of the student activity book; teacher guidebooks; a solar



The SolarSchools® curriculum guide provides a lesson plan for teachers on both renewable energy and solar electric power.

demonstration kit (for student demonstrations); presentations by guest speakers on a special "SolarSchools® Day"; an in-school assembly focusing on "Science Wonders" aimed at inspiring the interest of students in science; and help with local media coverage of their activities and programs related to the SolarSchools participation.

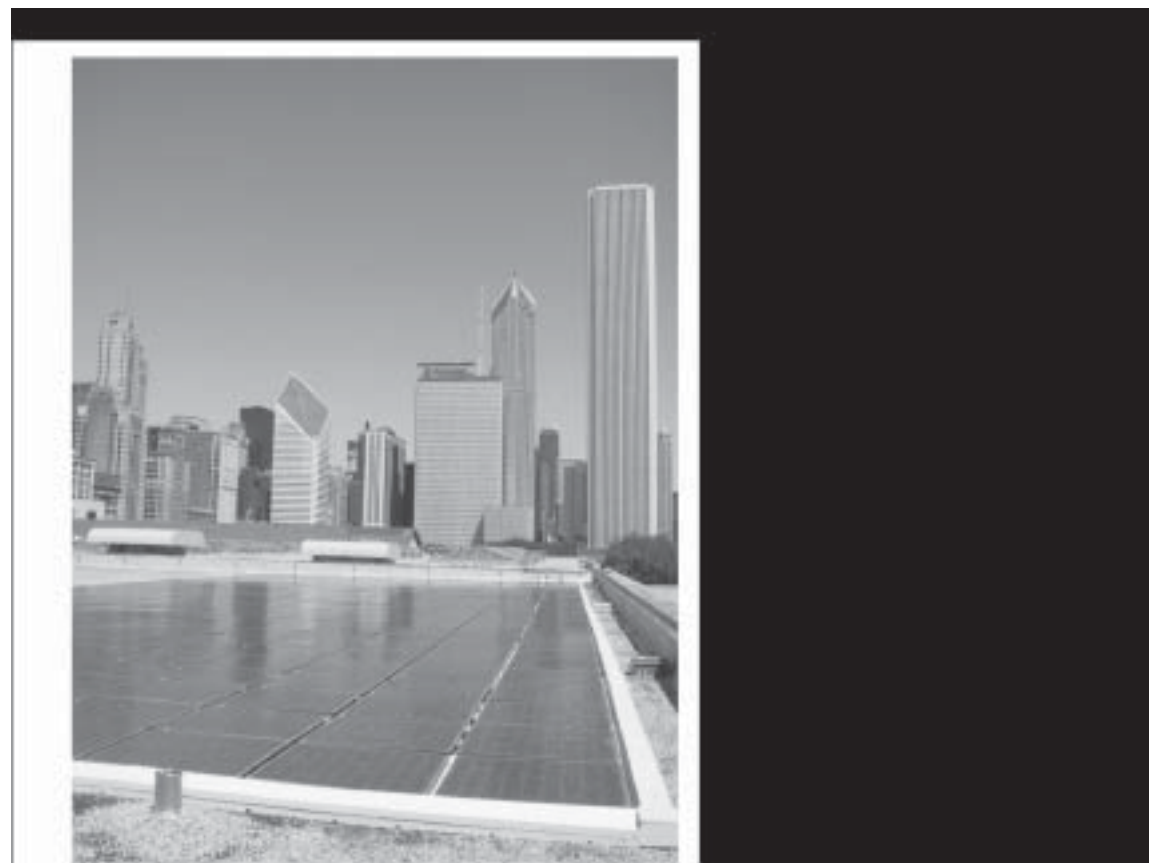
The SolarSchools program is helping to educate elementary school students in Michigan not only with basic educational skills, but also by teaching them about the importance and technical background of solar and alternative energy sources.

For more information, see www.dteenergy.com.

Holly Riester is the Program Manager for the Solar Electric Power Association.



Brownell High School students in Grosse Pointe, Michigan, are using hands-on applications of solar energy from their SolarSchools® curriculum, in this case, to demonstrate the use of the radiometer.



This Roof Supports More Than World-Renowned Art

Under the roof of The Art Institute of Chicago reside more than 250,000 works of world famous art and artifacts. On top of the roof sits more than 40,000 pounds of cutting-edge renewable technology. The largest such installation in Illinois, these solar panels represent just one part of ComEd's commitment to the promotion of renewable energy and energy efficiency and the support of environmental programs throughout Northern Illinois.

ComEd.
An Exelon Company

Solar Energy Used to Fight Poverty in Rural Areas

By Vincent Denby-Wilkes

Electricité de France (EDF) is actively promoting the development of solar power through its ACCESS (ACCess to Energy and ServiceS) Program. The goal of ACCESS is to bring electricity to rural communities in order to improve the quality of life while maintaining and supporting cultural diversity. Through ACCESS, and in partnership with other investors, EDF sets up Decentralized Services Companies (DSCs) in the rural areas of developing countries. These locally based DSCs aim at providing low-income end-users with access to electricity, most often generated by PV systems. DSCs have been established in Mali, Morocco, and South Africa; about 10 other projects are under study.

In mainland France and the four French overseas territories, the off-grid electrification program has brought electricity to more than 5,000 isolated households and users. Throughout the last 10 years, the vast majority of these remote sites have been equipped with stand-alone PV generators. Electricité de France; the French

education (electricity permits children to study more, small girls whose mothers spend less time searching for wood or preparing food can go to school, evening literacy classes can be organized, etc.).

The ACCESS Program has two aims: to satisfy the basic requirements of families and to stimulate the creation and development of revenue-generating activities. In order to provide for basic energy needs, ACCESS provides a sustainable energy service to households with monthly revenues in the range of 40 euros or less. The program is structured to provide a family with a low-cost solar electric system (or other form of generation) paid for by the family in monthly payments. When a project is developed, the program ensures that the monthly payment for the household is lower than their monthly expenses for traditional energies (kerosene lamps, batteries, candles, etc.). By ensuring that energy needs are satisfied in a low-cost way, the program enables the members of a community to be more productive and produce crafts or micro-industries

further develop the local economy. Locally produced energy and renewable energy are emphasized to strengthen community involvement and to minimize the environmental impact of the project. The ACCESS Program offers not just electricity services but also gas (small LPG bottles) for cooking in order to reduce deforestation and to improve the living conditions of women and children, in particular.

ACCESS projects combine local micro-grids and individual equipment and rely on the creation of local RESCOs (Rural Energy Services Companies), which employ and are managed by local people and form an integral part of the local community. The companies created by ACCESS encourage, in the regions where they are implanted, the development of community heritage areas which safeguard the national heritage while encouraging sustainable economic development.

The company capital consists of investments by EDF and its partners. To date, these partners have come from developed countries; however, partnerships are now being developed with local communities and small businesses leading to closer involvement at the customer level. Four local companies are in operation today: two in Mali, one in the cotton zone (8,000 family objective) and the other in the Senegal River zone; one in Morocco (16,000 family ob-



This home in Koutiala, Mali, receives enough electricity from its solar electric system to power a television, connecting viewers to the world.

sustainability of projects depends on the extent of their effectiveness in poverty reduction and rural development.

The ACCESS Program is aligned with the United Nation's

Johannesburg, Paragraph 18 noted the will to accelerate access to vital needs: drinking water, sanitation, energy, health, food security, and protection of biodiversity. Today, electricity is a vital product. Without electricity, no real development is possible. A company with its business in a vital product has a corporate responsibility to help developing nations. EDF considers that it is in a position to fulfill its obligations as far as possible. This is why EDF has set up the ACCESS Program for off-grid electrification intended for the poorest people in the poorest countries. The ACCESS Program corresponds to a major principle in EDF's agenda: "facilitating the access to energy of rural populations in developing countries."

This is a real struggle led by the energy industry in partnership with institutions, international aid agencies, and NGOs to take up the development challenge. This struggle will be won only where it satisfies the requirements of populations through sustainable and responsible development.

Vincent Denby-Wilkes is Director of the ACCESS Programme at Electricité de France.



A village in Kouri, Mali, benefits from EDF's ACCESS program.

governmental agency for the environment and energy management, ADEME (Agence de l'Environnement et de la Maîtrise de l'Énergie); and various other sources have provided financial aid and technical as well as institutional support.

Energy is critical to economic development, social development, and an improved standard of living. Access to energy impacts:

- the rural exodus;
- economic development;
- living conditions, particularly for women (facilitating their work, gaining time to develop revenue-generating activities, etc.);
- health (nighttime births are easier with electricity and babies do not have to breathe the fumes of the kerosene lamp, eye and lung diseases are reduced, etc.);

required for the economic growth of these regions. This presupposes that the energy made available is greater than the energy necessary to satisfy family lighting needs alone.

Local Control Strengthens Local Economy

Some basic principles guide the ACCESS Program: customer buy-in, local management, and preference for local and renewable energy sources. The program is structured so that participants purchase low-cost solar electric systems in order to give the customer a sense of ownership and responsibility and to enable each person to influence the sustainability of the project. ACCESS creates local companies, managed by local personnel, to

jectives); and one in South Africa (15,000 family objective).

The ACCESS Program works closely with financial partners, service providers, and other major companies, but also with public institutions and nongovernmental organizations (NGOs). ACCESS is also associated with other programs, such as remote satellite medical programs in rural areas. ACCESS Program partners include:

- ADEME (French Agency for the Environment and Energy Management);
- UNDP (United Nations Development Programme);
- Nicolas Hulot Foundation; and
- ENDA, an NGO based in Dakar [Senegal] specializing in energy and the environment.

The ACCESS Program is accompanied by an R&D program orientated toward not only economic and human development but also toward the expectations of populations, the solutions which need to be provided, and tools to monitor the situation. The

Millennium Development Goals and is monitoring human development indicators—health, education, and the economy. The fight against poverty is the overall Millennium Development Goal.

Energy is essential to human development. In the final declaration of the World Summit for Sustainable Development at



A solar electric system provided by the ACCESS program provides electricity to this maternity ward in Ourikila, Mali.

The IREC Chronicle

By Jane Weissman

When the Interstate Renewable Energy Council began its series of programs and outreach efforts to quicken the market adoption of solar energy, nobody anticipated the twists and turns our progress would take. IREC continues to reduce costs, eliminate barriers, and increase public acceptance of solar and renewable energy. Yet, without a healthy regard for flexibility and agility, IREC would have missed out on many subtle and not-so-subtle opportunities.

The projects in IREC's portfolio, although focused on different outreach strategies and stakeholder segments, complement each other. We cast our net widely, involving state energy offices, state fund managers, utility regulators, the solar industry, national organizations, utilities, municipalities, schools, and other community groups in our information dissemination and outreach work.

One of the most significant undertakings of our Interconnection Project in recent months has been participation in the Federal Energy Regulatory Commission (FERC) stakeholder process on national standardized interconnection rules. IREC has played a leadership role among the diverse but cohesive Small Generator Coalition, developing consensus rules for the interconnection of generators up to 20 MW in size. The rules, if promulgated by the FERC, would represent the only comprehensive effort to develop detailed rules that would be available to generators nationwide. While the rules would only apply to generators that are under FERC jurisdiction, the Chair of the Commission has articulated his hopes that these rules will be adopted by many states.

"There was a great deal of consensus among the parties on many of the technical elements of interconnection," Chris Cook, E3 Energy Services, LLC, tells us, "with major differences falling into the categories of interconnections to distribution networks, costs for the interconnection review, and the use of simplified screens for certain interconnections at transmission level voltages."

At the state level, several states have undertaken to review, modify, and expand their interconnection rules, prompted perhaps by the FERC actions and in response to a model for interconnection developed by the National Association of Regulatory Utility Commissioners. These include Connecticut, Massachusetts, Minnesota, North Carolina, Virginia, and Wisconsin. Other states have undertaken to review net metering rules, including Indiana, New Jersey, New York, and North Carolina. In California, work continues on Rule 21, a standardized rule for the interconnection of a wide range of generators, excluding those that export power into the grid.

Next on the IREC agenda is national standards for renewable energy professionals and training curricula. IREC has been working with the North American Board of Certified Energy Practitioners developing quality and competency standards for solar professionals, a critical component of bringing the solar industry into step with other

recognized craft labor forces. IREC's objective is to provide consumer assurances and assist both states and the solar industry in building a strong and qualified workforce. Along with installer certification, IREC is setting plans with the Institute for Sustainable Power and the Partnership for Environmental Technology Education to bring third-party verification to training programs, coupled with outreach to technical and community colleges.

IREC's Schools Going Solar Clearinghouse reports that solar school programs and installations continue to grow in number across the country. "An interesting and encouraging trend," observes Vicki Colello, the IREC Chair, "has been the growth of renewable and green buildings and programs in colleges and universities, often student-led." For instance, students at University of North Carolina at Chapel Hill initiated a referendum that was approved by 74 percent of the 7,000+ voters which added \$4 per semester to fees that will be used to install renewable energy technologies on campus and to buy green power. At the high school level, one of the more ambitious new programs will see 50 high schools in New York State with new two-kilowatt PV installations by fall of this year.

For the past year, IREC has joined the U.S. Department of Energy's Million Solar Roofs (MSR) team to help out with communications and outreach activities. New this year is the Conference Call Seminar Series—intensive 60- to 75-minute telephone seminars with expert speakers. The first seminar, on public sector solar financing, drew 57 attendees. The second one was on solar for affordable housing and more than 80 partnership members listened to presentations on the Colorado Court affordable housing development in Santa Monica and the Mississippi Development Agency's plans to install solar hot water systems for low- and fixed-income families. Larry Sherwood, Executive Director, Sherwood Associates, says, "This is a fluent way to bring key information to many people inexpensively."

The Million Solar Roofs web site (www.millionsolarroofs.org) has shifted into a higher gear these past months as new features are added regularly. Ace reporter Jane Pulaski keeps the information current and relevant, bringing news to and about MSR partnerships. Newsmaker interviews and partnership columns are some of the articles that appear on this website. This is a vibrant site to bookmark; it's worth frequent visits.

Need information on state and federal incentives and programs? DSIRE is the nation's most comprehensive, up-to-date source of detailed information on government and utility incentives, policies, and programs that promote the deployment of renewable energy technologies. DSIRE is online at www.dsireusa.org. It's a searchable database containing about 700 programs representing 27 different types of initiatives at the federal, state, and local government and utility levels.

On the IREC calendar, our annual meeting is on June 22 in Austin. It will be a joint meeting with Million Solar Roofs Partnerships.

Developing National Voluntary Certification for Solar Installers

By Wendy Parker

Over a thousand voluntary certification programs exist in U.S., qualifying professionals from crane operators to energy efficiency experts, from financial planners to automobile technicians. The time is now right to develop industry standards and a voluntary national credential for the solar industry.

Why certification for solar? Solar technologies are mature, proven technologies that can deliver impressive benefits to U.S. consumers and businesses with payoffs starting right away. The availability of federal and state incentives has caused impressive growth in the PV and solar thermal fields and has created some dramatic market conditions. As states and other public entities commit public funds to solar installation, they also require standards by which to judge and ensure that installations are done correctly. A set of national standards leading to voluntary certification can answer that need and help ensure the professionalism and growth of the solar industries.

For the past two years, the North American Board of Certified Energy Practitioners (NABCEP) has been working to develop standards and a voluntary certification for PV installers in the U.S. NABCEP is a volunteer board of renewable energy stakeholder representatives, each member chosen because of his or her experience and involvement in the solar energy industry. NABCEP is using a consensus-building process where Subject Matter Experts on the PV Technical Committee develop standards. Those standards and recommendations are

Several chapters of the American Solar Energy Society will also be represented there. Our goal is to provide a forum where information can be shared and new strategies can be learned among this synergistic group of state, local, and community stakeholders. The day before, IREC is joining forces with Pace University to bring a special forum for state stakeholders on *Understanding and Improving the PV Permitting Process*. IREC is also working with the states and industry on small wind energy issues, which started with a kick-off meeting on May 18.

Don't forget that the new edition of the "Solar Power is Going to Schools" booklet is available. Updated and expanded, this publication brings useful tips and examples to make solar school programs successful. And, IREC continues its most recent educational campaign, *Solar Means Safety*, integrating print materials and web-based resources designed to help communities use solar energy as a solution to our nation's energy problems. Information about these tools and other up-to-the-minute news on schools, interconnection issues, certification and training, and state activities are all easy to find at www.irecusa.org.

Jane Weissman is the Executive Director of the Interstate Renewable Energy Council.



National standards for voluntary certification will help to ensure the safety and performance of solar electric systems.

then subject to comment, expert review, and board approval.

In developing standards and certification for PV installers, NABCEP is following the best practices established by other certification programs in the U.S.

NABCEP's credential has been developed as a voluntary national certification as opposed to a license. A license is a credential required by a city, state, or federal government before someone can work in a given field. Solar installation is already regulated through licensure in several states. NABCEP certification will not displace or supersede this.

Instead, NABCEP certification will provide a voluntary credential throughout the U.S. for PV installers who feel they will benefit by it. Educating consumers and ensuring that NABCEP requirements and the certification exam are valid predictors of installer competence will increase consumer confidence in the solar field, helping the solar market grow.

The availability of a voluntary certification will reward PV practitioners who excel in their profession,

providing them with an additional marketing tool for increasing their business. In addition, work done by certified installers may benefit from lower insurance rates and financing organizations may be more willing to lend money to solar projects undertaken by a certified installer.

Finally, because it is voluntary, the NABCEP credential will not restrict entry into the field, which can cause installation costs to rise. NABCEP certification will not limit the expansion of the industry and may help significantly expand it. In addition, the existence of national standards, shaped by input from industry participants, may help prevent the proliferation of state and municipal prerequisites for installing solar can be a significant barrier to the growth of the industry.

In order to become certified, candidates will need to meet prerequisites of experience or training. They will submit an application, subject to review by PV experts, and sign an ethics statement. Candidates will receive approval to sit for the certification exam, which is a four-hour, written, multiple-choice, open-book exam that will be scheduled at selected locations. After passing the exam, a practitioner will be certified and will be able to display NABCEP credentials.

NABCEP plans to make the first certification exam publicly available in the Fall 2003, releasing the test locations and applications in June 2003.

By participating in the NABCEP process, PV installers, manufacturers, educators, and others are helping shape the future growth of their industry.

Wendy Parker is a Project Coordinator with the North American Board of Certified Energy Practitioners.

Using Solar Energy To Power DC Loads

The Electric Power Research Institute (EPRI) is testing a unique approach that has the potential to drive down the cost of solar electric (photovoltaic) power by using it to power direct current loads that are located at grid-tied facilities. EPRI, the Salt River Project, and the Illinois Clean Energy Community Foundation are funding the project.

The theory behind the project is that the electricity needs of certain applications closely match the output of a solar electric system. Because the electric power generated by a photovoltaic system is DC, and is most often converted to AC for use, using the electricity to power a DC application maximizes efficiency. The cost of the solar electric system is also reduced because the need for an inverter—used to convert DC electricity to AC—can be eliminated.

There are several financial and technical barriers to using solar power to provide DC electricity for loads connected to the grid. Some modification of the

load may be necessary to adapt it to a PV system, increasing the expense and potentially posing some technical difficulties. There may be problems if a continuous power supply is needed, since the PV system will only function when the sun is shining. The load must have an alternate source for power, a battery back up, or only operate when the sun shines.

Should these barriers be overcome, this could prove to be a new niche for solar electric power—increasing the demand, helping to provide a steady market, and, ultimately, driving down the cost of solar power.

The project has three stages. The first is to investigate the loads that would be suitable for this type of application. The second is to have a demonstration project. The third is to monitor the demonstration project for six months to determine performance and economics. The first phase has been completed, and EPRI will select one or more demonstration sites this summer.

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