The SEPA Record All the Latest News Supported by About Utilities and **Electric Power** Their Involvement Research in Photovoltaics Institute **FALL 2002**

WASHINGTON, D.C.

The Integration of Solar Electric into Buildings Solar Electric at the White House and Around the World



Steven Strong, President of Solar Design Associates, stands with the 10-kWp PV array his firm designed to feed solar-generated power into the White House distribution system; it was completed this summer.

Two New Solar Facilities Dedicated in the State of Texas

By Jordan Parker

A U.S. and a Dutch energy service provider have joined to install two new solar electric systems in Texas. Both facilities were dedicated recently.

Green Mountain Energy Company, the nation's largest and fastest growing retail provider of

cleaner electricity, and Nuon, the Netherlands's largest utility and a leader in renewable energy development, have teamed up to harness the power of the sun to generate pollution-free electricity. The two new solar facilities are at the Winston School in Dallas and in the Upper Kirby District Foun-



dation building in Houston.

The Winston School, on Royal Street in Dallas, hosts a 6,600-square-foot, 57-kilowatt rooftop solar array. The facility located atop the Upper Kirby District Foundation building on Richmond Avenue in Houston is a slightly smaller array covering 6,085 square feet, and is rated at 43 kilowatts.

Each installation is larger than a professional basketball court. Over their 20-year expected lifetime, these systems will prevent 6,355 tons of carbon dioxide, 24 tons of nitrous oxide, and 45.4 tons of sulfur dioxide emissions from entering the environment.

The Winston School, a coeducational college preparatory school serving "bright students who learn differently," will be the first Green Mountain Energy Company solar site to incorporate real-time data from the PV system into its curriculum. The school participates in various community projects, including a solar car program designed to develop self-esteem through a real sense of accomplishment. The program also helps other schools in Texas, around the nation, and all over the world learn how to start their own solar programs, through quarterly workshops and their solar website. Their main project is the Winston Solar Challenge, an international education program designed to teach children the technology and physics behind a road-worthy solar vehicle. The Challenge consists of both cross-country races and closed-track races at the Texas (continued on page 2)

By Steven J. Strong

Ed. Note: There are three recently installed solar systems at the White House in Washington, D.C.—a building-integrated PV system and two solar thermal systems. These systems, designed by Solar Design Associates, highlight the importance of using solar energy integrated with the building structure. Completed this summer, the roof-top PV system features modules from Evergreen Solar and was installed by Aurora Energy.

There is a growing consensus that distributed PV systems that provide electricity at the point of use will be the first to reach widespread commercialization. Chief among these distributed applications are PV power systems for individual buildings.

Interest in the building integration of PV (known as BIPV), where the PV elements actually become an integral part of the building, often serving as the exterior weathering skin, is growing worldwide. With reduced installation costs, improved aesthetics, and all the benefits of distributed generation, building-integrated PV systems are the prime candidate for early widespread market adoption.

Innovative architects the world

over are now beginning to integrate PV into their designs and PV manufacturers are responding with modules developed specifically for BIPV applications, including integral roof modules, roofing tiles and shingles, modules for vertical curtain wall facades, sloped glazing systems, and skylights.

Designing with BIPV

The earliest BIPV system was a 7.5-kWp residential application completed in 1980. The Carlisle House, as it became known, was designed by Solar Design Associates and cosponsored by the Massachusetts Institute of Technology and the U.S. Department of Energy. This future-oriented house was all-electric with no fossil fuel burned onsite. The surplus electricity it produced was exported to the local utility grid via a "net metering" arrangement, using the grid in lieu of onsite storage.

Other early projects in the United States included the 200kWp Solarex (now BP Solar) facility in Frederick, Md. (1982), and the 325-kWp Georgetown University Intercultural Center in Washington, D.C. (1985). Aggressive efforts in Europe and Japan begun in the early 1990s have pulled the technology forward toward

(continued on page 4)

Austin Energy Brings Green Pricing to Texas

Austin Energy has proven itself as a leader in the utility industry by establishing a successful, innovative, green pricing program.

The utility's success with green power dates back to its Solar Explorer program in the mid-1990s. Solar Explorer facilitated the installation of 28 PV systems on customer rooftops. The systems were utility-owned, but leased to the customer for 10 years at a nominal rate of \$15 to \$30 per month. Following the success of Solar Explorer, in January 2000 Austin Energy launched GreenChoice, a green pricing program that offers customers the option of purchasing 100 percent of their energy from renewable sources at a premium price.

term contracts with suppliers of renewable energy to purchase energy at a fixed price for the duration of that contract. The energy generated from these sources is branded "Austin Energy," and the utility earns renewable energy credits for that generation. Because Austin Energy receives the renewable energy at a fixed price, it offers customers who sign onto the GreenChoice program a fixedfuel charge for the duration of that customer's contract, usually 10 years. Electricity prices have fluctuated dramatically since the inception of the program; in some cases, the fuel charge has been markedly higher than the fixed rates of early GreenChoice participants. Cus-(continued on page 2)

The Winston School, in Dallas, Texas, houses a 57-kW roof-mounted photovoltaic system. Data generated by the photovoltaic system is incorporated into the school's educational curriculum.

INSIDE

- 2 For PV, Generating Energy is What Counts
- 3 Students Vie in Solar Decathlon in Capital
- 5 Big Businesses Benefit from Solar Photovoltaic Power
- Tools for Easy Solar 5 **Education Outreach**
- 6 III. Highlights PV Industry
- 7 Solar Electric Business Directory
- 11 Addressing the Barriers to Commercialization
- 13 A World Perspective on the Need for Solar
- 14 Tips for Homeowners Interested in Solar
- 14 In Springerville, One of the Largest Gets Larger
- 15 Rays That Pay!
- 16 Aligning Common Interests for the Success of Solar

Austin Energy secures long-



A ground-mounted PV array provides shading for the taxi stand at the Austin airport as part of Austin's Energy green pricing program.

Two New Solar Facilities Dedicated in the State of Texas

(continued from page 1) Motor Speedway. This project benefits the children by focusing on creativity and team problem solving but also delivers international and nationwide education on alternative energy.

The Upper Kirby District Foundation building is an important part of the community and houses such groups as the building's namesake foundation, the Houston Intown Chamber of Commerce, The Sierra Club, The Nature Conservancy, Bridges to Sustainability, Crisis Intervention, and the Citizen's Environmental Coalition, among others. The Upper Kirby District Foundation is a not-for-profit organization that promotes the vibrant existence of residences and commercial business in the Upper Kirby District of Houston, and acts as the local Chamber of Commerce. The organization publishes a monthly newsletter with a circulation of about 30,000. The foundation is actively involved in helping to promote its new 43-kW PV generation system.

Staff at Green Mountain Energy feel that the new solar facilities are a direct result of continuing customer support for renewable energy. Their customers in Texas enjoy the option of signing up for the company's 100 percent wind power electricity



The 43-kW photovoltaic installation on the Upper Kirby District Foundation building in Houston helps offset the building's electricity load. This facility provides office space for the Houston Intown Chamber of Commerce, The Sierra Club, The Nature Conservancy, Bridges to Sustainability, Crisis Intervention, and other groups.

program or the Big Texas Sun ClubTM to help construct, develop, and maintain new solar facilities in Texas. The programs also promote ongoing statewide education about solar energy.

"As a company dedicated to improving the environment and investing in sustainable energy technologies, Nuon is proud to participate in a project that provides clean energy and educates the public at large," said Matt Cheney, Chief Operating Officer of Nuon Renewable Ventures USA. "We feel that there is a bright future for more projects like these in Texas."

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For PV, Generating Energy is What Counts

By Tom Hunton

Solar electricity is like a breath of fresh air—clean and satisfying. It can sustain our natural environment, improve the reliability of our electric grid, and create new, high paying jobs across the country.

Unfortunately, the solar electricity industry (or photovoltaics, PV for short) has been performing a disservice to the consumer. The solar PV industry has been selling solar systems based on the number of panels (or the number of kilowatts) installed rather than the energy flowing into your home or business. You would get the impression that the number of solar panels installed on your roof is all that matters. The fact is, it's the energy being generated by the panels that counts. The more electricity flowing from a solar PV system, the more good you do for yourself and the environment, the fewer new fossil fuel plants need building, the fewer greenhouse gases are emitted, and the closer we get to the vision of solar PV as a mainstream source of clean, reliable power.

A fixation on size in the PV industry is okay, if we measure the right thing! Today, when you pur-

BP Strives to Be A 'Force for Good'

Austin Energy Brings Green Pricing to Texas

(continued from page 1)

tomers who signed up for GreenChoice early on have already experienced a savings on their electricity bills. Austin Energy expects to offer an even lower fixed rate to its GreenChoice customers.

Steady Growth for Green Pricing

Unlike many other green pricing programs that have been met with mixed success, the GreenChoice program has enjoyed steadily growing interest and participation. The success can be attributed to Austin Energy's marketing technique. The utility provides speakers, free of charge, to give informational presentations to small groups. This focused interaction helps to educate consumers about the importance of their energy choices, provides opportunity for questions and answers, and usually results in more than 90 percent of the people in attendance signing up for the GreenChoice program. Currently, Austin Energy's generation mix includes three percent from renewable sources which, by 2003, will increase to five percent. Wind power generates approximately 80 percent of the renewable energy, 19 percent is from biomass and landfill gases, and less than one percent comes from solar.

ergy generation, it is the only distributed resource, is ideal for offsetting peak demands, and unlike wind and biomass—the PV systems are actually owned by the utility. According to Mark Kapner, Manager, Renewable Energy & Conservation at Austin Energy "PV has a broader function than energy generation. It is the most visible technology in the GreenChoice program and the technology that customers find most intriguing."

While Austin Energy does not expect to make solar a higher portion of their renewable energy mix, it is a critical component of their program and several high visibility installations are under development. The new Austin City Hall will feature a building-integrated solar canopy. Other systems are planned for a parking garage near the utility's offices, the convention center, and a nature preserve. UPEx'02 attendees will see an Austin Energy system at the Austin airport taxi stand. The utility is also beginning to work with the community, contractors, and financing entities to further develop the local solar infrastructure.

A new BP advertisement questions, "Is it possible to drive a car and still have a clean environment? Can solar power become mainstream? Can business go further and be a force for good? We think so."

With the intention of boasting bright, open, and friendly pumping, BP's solar-assisted, "gourmet" gas stations have a new, futuristic look. British Petroleum (BP), one of the world's largest petroleum producers and the largest manufacturer of solar modules, has incorporated its own thin-film solar modules into pump island canopies to generate electricity.

Each new station has "enough [solar energy] to power about five homes or roughly 10 to 15 percent of the site's overall energy needs," according to a press release. The translucent solar panels protect motorists and create an atmosphere that lends to the petroleum mogul's recent image transformation into an eco-friendly and responsible energy supplier, a goal of its new ad campaign, Beyond Petroleum. "In addition to being one of the largest manufacturers of solar panels in the world, BP is the largest commercial user of solar power," says Polly Flinn, senior vice president for BP's U.S. Retail Operations. "To date, we have installed solar panels at more than 380 of our retail sites worldwide. Counted together, these panels are producing more than six megawatts of electricity per day and reducing harmful carbon dioxide emission by 6,500 tons per year."

ered "BP Connect" convenience stores in the City of Chicago alone, which feature not only solar modules but also gourmet coffee and online kiosks where customers can check weather, traffic, sports and general news, and find directions.

BP's move to lead the energy industry into a new realm of environmental responsibility has found widespread support. "While other oil companies keep their head in the sand, BP Amoco makes progress on global warming, environmental monitoring, and alternative energy sources," said Phillip Johansson in an article from SocialFunds.com. The Wall Street Journal notes that BP is at the forefront of the movement by corporations to address the issue of climate change, and that this year its managers are being evaluated for their efforts to cut emissions as well as for their financial performance." According to BP, the Beyond Petroleum campaign saw a 13 percent approval vote from shareholders, which is actually fairly high considering that approval for similar resolutions at BP is usually in the single digits. "What you're seeing now is heavy industry splitting into the leaders and the ostriches," said Bob Massie of the Coalition for Environmentally Responsible Economies in the SocialFunds article. "You are seeing an increasing number of leaders who are willing to talk about global warming and think about this as part of their strategy, and who understand that the science is not only overwhelming but who don't want to fight that battle any more." It looks like it intends to be a leader.

chase a 100-kilowatt solar PV system, you have no idea how big the system really is. Why? Because size of a system depends on the energy flowing from it, not the area on your roof it covers. Depending on how it's installed, 100 kilowatts of PV could create up to 50 percent more or less electricity.

For example, which system is bigger, System A or System B?

■ **System A**: 100 kilowatts producing 2,000,000 kilowatt-hours of electricity over 10 years.

■ **System B**: 110 kilowatts producing 1,500,000 kilowatt-hours of electricity over 10 years.

Traditionally, System B has been sold as the superior arrangement because it has more installed kilowatts. However, generating (continued on page 6)

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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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While the solar energy makes up only a small percentage of the total renewable enFor its distinguishing achievements as a green power supplier, the U.S. Environmental Protection Agency presented Austin Energy with the Rudd Mayer Green Power Pilot Award in October 2002.

During the next five years, BP plans to build five new solar-pow-

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Students Vie in Solar Decathlon Competition in Capital

Fourteen university teams showed off their finished wares on the National Mall in Washington, D.C., during the U.S. Department of Energy's first-ever Solar Decathlon, a national competition to design and build houses that only use solar electric and solar thermal energies. This competition involved blending building aesthetics and modern conveniences with maximum energy production and efficiency.

"The U.S. Department of Energy is proud to sponsor the firstever Solar Decathlon," announced Secretary of Energy Spencer Abraham, "a university competition that brings together our nation's brightest minds to demonstrate practical ways of producing and using energy efficiently in the home."

For the competition, the solar decathletes had to develop ways to harness the power of the sun to supply all the energy for an entire household, including a homebased business, and all the accompanying transportation needs.

Each house was judged on 10 criteria to determine which home most efficiently employed solar energy for heating, cooling, hot water, lighting, appliances, computers, and charging an electric car. While each team showed exceptional talent for this first-of-itskind challenge, the University of building blocks, the different modules can be arranged to create a variety of layouts catered to the whim of the owner.

The second place team, from the University of Virginia, utilized aesthetics and specially chosen materials to make their design stand out. The radical aesthetic employed by their architecture team combined fast-growing birch and bamboo in addition to materials recycled from derelict houses, like copper cladding for the roof.

Some observers familiar with the solar industry wished they had seen a better overall utilization of building-integrated PV technologies, but declared the event a success. And blazing mid-day temperatures couldn't deter curious visitors who suffered in long, hot lines to catch a glimpse of the unique designs inside each house. Students were thrilled, too, to have managed the various challenges and successes of their projects into an end product.

"I just graduated from architectural school," said University of Virginia student Josh Dannenberg, summing up his experience. "This is the perfect segue to working in an architectural practice. Architecture students are used to working alone in the studio on their own projects. Now, I'm working with 12 architectural students and we're collabo-



The Solar Decathlon attracted large crowds while the homes were on display in Washington, D.C., during a sunny week in early October.

Colorado at Boulder took first rating with the engineering stuplace.

dents.... We're collaborating with The decathlon began on people in the community and deal-Earth Day last April. Each team ing and negotiating with contrac-



While on display on the Mall in Washington, D.C., visitors tour the Solar Decathlon's winning entry, designed by students at the University of Colorado at Boulder.

N.J. Residents Receive Rebates For Generating Own Clean Power

New Jersey customers receive a rebate for any solar electric, wind, fuel cell, or sustainable biomass system they install under their state's Clean Energy Program. Seven electric and gas utilities administer the customer-sited clean generation program, which offers, on a statewide basis, both financial incentives and training to build the clean energy market in New Jersey.

Since the inception of the program in May 2001, \$21 million have been reserved to support the installation of almost nine megawatts of clean energy systems. Twenty-eight systems are completely installed, with the balance in progress.

There is no maximum system size, but it must be large enough to meet specific electricity needs of the customer. Participants receive a rebate of up to 60 percent of the installed cost on one-megawatt or smaller systems.

Jersey Central Power and Light, operating company of SEPA member FirstEnergy, has taken the lead in administering the program. Annual funding for the program amounts to about \$15 million per year for three years. An additional \$15 million per year is designated for utility-side projects and another \$85-\$90 million per year is set aside for three years for energy efficiency initiatives.

materials include *Plug into the* Sun, A Guide to Buying a Solar Electric System, as well as both a residential and commercial brochure and a renewable energy information pamphlet for school-age children.

As a part of the rebate program, New Jersey has net metering interconnection requirements that enable solar electric and wind systems up to 100 kilowatts in size to be connected to the utility grid. Like the net energy program in Hawaii (see article, page 15), the New Jersey program differentiates between nonresidential and residential facilities in the number of projects allowed to use the incentives program.

According to Dr. David Nichols of the New Jersey Division of the Ratepayer Advo-"nonresidential cate, customers have participated in the program to a moderate degree, installing larger solar photovoltaic cell systems and natural gas fuel cells." But, says Elaine Bryant of New Jersey Clean Energy, "participation among residential customers who would install tems-such as rooftop photovoltaic modules under 10 kilowatts-has been below expectations to date, despite intensive marketing outreach."

Bryant also indicated that the market price of residentialsize renewable energy systems is usually higher per kilowatt than the per-kilowatt price for commercial-sized systems. "Based on these considerations, I suggest that the incentives for small-sized systems [below 10 kW] be increased substantially."

Like the effects of the net energy metering law in Hawaii, participation in residential versus nonresidential programs is uneven. In both New Jersey and Hawaii, although interest seems high and the programs are offering financial incentives, funds are currently underutilized by residential customers.

Nevertheless, the New Jersey Clean Energy Program offers one of the best strategies towards developing a viable clean energy industry in New Jersey. For information on participating in the program, visit

designed and built its own residential PV-equipped house, which was powered entirely by the sun. For competition purposes, each house was limited in size to 500 square feet. The teams received solar energy and building design tutorials from the National Renewable Energy Laboratory and \$5,000 stipends from the U.S. Department of Energy. Each team raised additional dollars to fund the remaining balance of their project costs.

Some teams designed their homes to be the most energy-efficient, while others focused on livability and aesthetics. The winning U.C. team even developed their own building system, called BASE+ (Building A Sustainable Environment). BASE+ is a flexible and repeatable way to build homes which showcase renewable energy systems and environmentally sound building products. Like

tors.... We're applying our design skills and actually building something."

The competition included teams representing the following universities:

- Auburn University (Alabama)
- Carnegie Mellon University (Pennsylvania)
- Crowder College (Missouri)
- Texas A&M University
- Tuskegee University (Ala.)
- Univ. of Colorado at Boulder
- Univ. of Delaware
- Univ. of Maryland
- Univ. of Missouri-Rolla/RTI
- Univ. of North Carolina at Charlotte
- Univ. of Puerto Rico
- Univ. of Texas-Austin
- Univ. of Virginia
- Virginia Polytechnic Institute. For further details, see the DOE's Solar Decathlon website at www.SolarDecathlon.org.

In addition to rebates, the New Jersey Clean Energy Program also offers technical training and educational materials. One course is designed to train individuals interested in learning how to install solar electrical systems. Through lectures, experiments, demonstrations, and hands-on experience, participants learn the basics of solar electricity, the intricacies of solar electric systems, and, finally, how to install a system. Educational

smaller renewable energy sys- the web site at <u>www.njcep.com</u>



Building-Integrated PV Systems

(continued from page 1)

broader commercial acceptance. Today, designers and engineers from more than 15 countries are participating in coordinated international activities, under the International Energy Agency's expert working group, to develop and implement BIPV programs.

It is essential to appreciate the context within which solar electricity can best function in a building. BIPV systems are only a part of the solution. We must address both sides of the energy use equation: supply and consumption. To maximize the solar contribution, the building should be designed to use energy most efficiently, with every aspect in the design process assessed with consideration for reducing the energy impact of the building. Energy generated from renewable resources will contribute a great deal more to an energyefficient building. Only within the context of a comprehensive energy-conscious "whole building" design strategy can BIPV achieve its full potential.

In the past, incorporating PV into a building design required unwelcome trade-offs and concessions in the architectural design process. Today, as PV manufacturers match products to building-industry standards and architects' requirements, this is changing. Companies in the United States, Japan, and Europe are actively pursuing new module designs that displace traditional building materials.

In the mid-1990s, Solarex (now BP Solar) developed a line of preengineered building-integrated PV components for commercial building facades and sloped glazing applications, called PowerWallTM, in conjunction with architectural curtainwall giant Kawneer of Atlanta, Ga. United Solar Systems (Troy, Mich.) fashioned its triplejunction amorphous silicon (a-Si) PV into roof shingles and standing-seam architectural metal roofing. BP Solar is currently developing a line of transparent thin-film modules suitable for overhead glazing systems and vision glass. Other architectural module designs employ glass-superstrate, crystalline modules with space between the cells and opaque backings, to provide diffuse daylighting along with their electric production. These new building-integrated photovoltaic components are providing a window into the future of solar architecture. With the right design, the sunlight falling on a building and/or its site can provide much or all of the power it requires. In urban areas, you can only imagine the power which will be generated by incorporating PV into the thousands of square kilometers of empty flat roofs and other available building surfaces which receive generous amounts of sunlight just waiting

the first U.S. application of insulated "solar electric glass." Solar Design Associates worked closely with HOK's green design group in their St. Louis office to design and integrate the BIPV system with the building design and then worked with the curtain wall, glazing, and PV manufacturers over a two-year period to develop the first-of-itskind transparent, insulated PV glazing elements for use in architectural glazing systems. The solar electric glass provides daylighting, cooling load mitigation, glare control, and solar-genvestment analyses based on utility savings because the funding came from their budgets while architects had to spend additional resources to construct a parapet screen to hide the unsightly PV arrays on the roof. The irony is that when a solar electric building skin is integrated, a cash flow stream is provided to the building owner on day one and for decades to come, whereas a granite facade will deliver only prestige.

Future Outlook

Today, there are more than one million homes worldwide us-



The first U.S. application of insulated architectural PV glazing was installed at the University of Wisconsin-Green Bay. The system, designed by Solar Design Associates, provides daylighting, cooling load mitigation, and solar-generated power to the new student center.

erated renewable power for the building.

What's the Payback?

While the cost of solar electricity continues to drop and will soon be competitive in many areas, it is instructive to examine how we as architects invest our clients' resources. Every building that is designed and constructed (with the exception of corrugated metal self-storage warehouses and the like) has some portion of its design and construction resources allocated to make it special: to define and create a unique character or make a "statement" on behalf of the owner and/or designer. This has traditionally been accomplished by using so-called "premium" building materials such as imported granite facades, marble interiors, curved glass walls, and made-to-order facade systems. The interesting thing to note is that many of these premium exterior cladding systems cost nearly as much as and, often, even more than a solar electric skin and none of them ever undergoes a returnon-investment analysis prior to being specified.

ing PV to supply or supplement their electricity requirements, although the majority are rural or remote off-grid applications. In addition, there are already many thousands of commercial buildings using integral or retrofit PV systems interfaced with the utility grid in Europe, Japan, and the U.S.

The potential opportunity for building-integrated PV systems is enormous, and many companies are now beginning to work on the development and commercialization of specialized BIPV components and systems. Residential and commercial BIPV will likely be the nearestterm large-scale markets for PV in the developed countries. As building-integrated PV components become an integral part of the form and aesthetic of the built environment, these systems are helping to define a whole new architectural vernacular in environmentally responsive buildings whose primary design goal is to harvest their own energy. This new generation of buildings will contribute greatly to a more sustainable future for their owners, their communities, and society at large. Steven J. Strong is President and founder of Solar Design Associates, Inc., located in Harvard, Massachusetts, U.S.A.. Tel: 978. 456.6855. eMail: sjstrong@ solardesign.com.

Member Activities

AstroPower, Inc.

R&D Magazine named AstroPower's eight-inch Apex solar cell one of the 100 most technologically significant new products of the year. The APx-8 solar cell is the largest, most powerful solar cell available within the solar electric power industry, and is manufactured via the company's proprietary high-speed, continuous-sheet silicon-film process. Currently in commercial volume production, the APx-8 solar cell is suitable for a variety of applications, including building-integrated photovoltaics, and offers unmatched power in an eight-inch package.

AstroPower's SunUPS and SunLine Solar Electric Home Power Systems will now be featured in Home Depot stores throughout Long Island, N.Y., five stores in southern New Jersey, and four in Delaware. This expansion brings the total number of Home Depot locations that carry AstroPower's solar electric home power systems to 61. These include 18 stores in greater San Diego as well as 16 in the Los Angeles metropolitan area. Through displays at each of these stores, customers learn how easy it is to generate their own clean electricity with AstroPower solar electric home power systems.

Austin Energy

The number of Austin Energy customers subscribing to Green-Choice, a green pricing program offering clean renewable energy at a premium price, has climbed to over 150 businesses and more than 6,700 residential customers. Subscribers use more than 240 million kilowatthours of green power annually.

CSG Services, Inc.

The organizers of the Texas Renewable Energy Roundup turned to CSG Services to provide 100 percent solar power for the event. The electricity was generated by solar electric systems at ten public schools in Texas and transferred to the Roundup in the form of renewable energy certificates.

Evergreen Solar, Inc.

Evergreen Solar has partnered with Conservation Services Group to install 10-kW PV systems on four BJ's Wholesale stores in Long Island, N.Y. These systems receive rebates from Long Island Power Authority (see the stalled at the Hilo bay front restrooms. This project includes an educational kiosk featuring a display on the Million Solar Roofs Initiative and the Island of Hawaii MSRI Partnership. A third lighting project was recently completed at the Ka Hale O Kawaihae transitional shelter for the Catholic Charities Community and Immigrant Services to provide security for the shelter's parking lot.

Los Angeles Department of Water and Power

In unprecedented action to expand the LADWP Solar Incentive Program, the Board of Commissioners has approved measures that will increase incentive payment limits, extend the highest incentive levels for another year, and expand the program by allowing large customers to participate in both the LADWP incentive program and a rebate effort of another local utility.

Incentive payment limits for commercial and industrial customers were doubled from \$1 million to \$2 million per project and increased from \$50,000 to \$60,000 per project for residential customers. The highest incentive payments of \$4.50 per watt and \$6.00 per watt for systems manufactured in Los Angeles were extended for an addition year until the end of 2003. The overall solar program was extended to 2010.

North Carolina Solar Center

The N.C. State University Solar Center, with support from the National Renewable Energy Laboratory, recently completed Case Studies on the Effectiveness of State Incentives for Renewable Energy. This study details the performance of 10 financial incentive programs in six states and clarifies the key factors that influence the effectiveness of each at stimulating the adoption of renewable energy technologies. Based on a number of common themes that emerged regarding the effectiveness of all of the programs examined, the report makes several recommendations to policy makers to improve the effectiveness of incentive programs.

PowerLight Corp.

PowerLight has announced that it will install what is claimed to be the largest commercial solar rooftop electric system in North America at Toyota Motor Sales USA Inc. (Torrance, Calif.), headquarters. The 501-kW solar system, which covers 52,000 sq. ft. and features 3,300 PV tiles, will be installed by fall of 2002 at Toyota's South Campus expansion project. "We are extremely pleased to see Toyota join the growing roster of leading companies that are realizing the benefits of deploying clean, reliable, and cost-effective solar power," said PowerLight President Daniel Shugar.

A good example of the integrated design approach is the new Cofrin Academic Center designed for the University of Wisconsin at Green Bay by Hellmuth, Obata, and Kassabaum (HOK). The facility features a student lounge whose south-facing sloped glass atrium and curtain wall incorporate

to be harvested.

In the past, solar electricity has been subjected to unrealistic shortterm payback demands. To justify the capital investments in PV, facilities managers have historically had to perform rigorous return-on-instory on page 15).

Hawaii Electric Light Company

As team leader of the Island of Hawaii Million Solar Roofs Initiative Partnership, HELCO was recently awarded a U.S. Department of Energy MSRI grant for \$50,000 for several projects to increase the acceptance and use of solar technologies on the Big Island. The projects include workshops on solar technologies, designing and installing code-compliant PV systems, and integrating solar education curricula into school classrooms. Also, a one-kilowatt solar electric system was installed at a local public school in conjunction with the State Dept. of Education.

Additionally, HELCO is working with the County of Hawaii to install solar lighting at two remote county parks and has just completed a solar lighting system in-

Wisconsin Public Service Corporation

This fall, three new high schools were added to the SolarWise for Schools program. Ashwaubenon, D.C. Everest, and Wabeno high schools each received two-kW solar electric rooftop installations. The SolarWise program now includes 18 schools, all of which use the solar electric systems as a tool in their educational curriculum.

Big Businesses Benefit from Solar Photovoltaic Power

Large corporations like Volkswagen, Toyota, and Ortho-McNeil Pharmaceuticals are proving critics wrong by finding an increasing number of roles for solar electric (photovoltaic, or PV) applications among their normally high-load applications. In the process, they are dispelling myths that PV technologies only serve a lowenergy demand, boutique market.

Executives have found that PV systems increase their companies' peaking power capacity during periods of heavy grid demand when electricity costs are highest on the open market. Also, utilizing renewable energy technologies shows their intention to operate in an environmentally responsible manner, a quality that has recently become a valuable marketing tool for some companies.

Volkswagen AG/BP Solar

Volkswagen AG announced in September 2002 that it had signed a cooperation agreement with BP Solar to equip new and existing German VW car dealerships with solar roofs. By incorporating solar power in their buildings, Volkswagen complements its image as an environmentally responsible business doing its part to reduce CO2 emissions.

Furthermore, "the project highlights the economic and ecological use of photovoltaic components as a modern and elegant building material," said BP Solar architect Mechthild Winking. BP and Volkwagen hope to complete 50 projects by the end of 2003.

Toyota

In September 2002, Toyota Motor Sales, USA, and PowerLight announced plans to install North America's largest commercial solar rooftop system: a 501-kW system at the company's facility in Torrance, California. This project will let Toyota lower its operating costs and reduce its need to purchase expensive peak-demand electricity (those times when grid electricity prices are highest and most vulnerable to blackouts).

The PowerLight solar system will cover 52,000 square feet of Toyota's South Campus expansion effort and will feature 3,300 solar electric tiles placed on the structure's flat roof. Toyota's twobuilding, five-pod South Campus expansion is on track to receive a (LEED) from the U.S. Green Building Council.

"Generation of solar electricity is very consistent with Toyota's commitment to continuously improving every aspect of our company's operations," said Sanford Smith, TMS Corporate Manager of Real Estate and Facilities. "This solar electric system supports Toyota's top initiative regarding the environment and demonstrates our commitment to the environment."

Mauni Lani Resort

The Mauna Lani Resort, a subsidiary of the Tokyu Corporation, adopted solar energy technology to reduce operating costs, limit fuel price volatility, and contribute to Hawaii's sustainability and environmental preservation. The resort is located on the Kohala Coast of Hawaii, an island with some of the highest electricity rates in the U.S. Currently, the Big Island burns diesel fuel to generate much of this power.

The resort began installing solar technologies—including a rooftop 100-kW PowerLight PV system, a 140-kW system at the resort's golf facility, and a 288-kW ground-mounted system—in May 1998. By January 2002, the Mauna Lani Resort had installed five systems totaling more than 43,000 square feet of PV surface, over 600 kW of solar electric power, and solar-powered golf carts.

Mauna Lani Resort projects will net an energy cost savings of \$5 million over the next 25 years.

Cypress Semiconductor

Cypress Semiconductor is a global supplier of high-performance integrated circuits located in the California's Silicon Valley. The company knows the state's precarious energy supply situation well and has taken steps to offset expensive peak power purchases from the utility grid. The company decided to install a 335-kW Powerlight PV rooftop array atop its new headquarter buildings in San Jose, covering 32,750 square feet of combined roof area.

These PV systems are lightweight, building-integrated photovoltaic (BIPV) roofing assemblies installed over the existing roof membrane. The output from the PV system is connected to the buildings' service panels. The roof pan-



Cypress Semiconducter enlisted PowerLight to install this 335-kW roof-mounted photovoltaic array at its headquarter buildings in San Jose, Calif.

sulation and thermal reflection features.

Fetzer Vineyards

Fetzer Vineyards is a large producer of wines located in Hopland, California. Given the dynamics of California's energy market, Fetzer decided to purchase 100 percent renewable energy for all of its winery and visitor center operations.

Fetzer has also installed a 41kW Powerlight PV array, covering 3,750 square feet, at its administration building. This array is gridconnected and supplies 75 percent of the administration building's annual electricity needs. Often, generation exceeds the daily loads and the system returns the surplus to the grid.

The array is comprised of 90 sloped roof modules, each with a maximum rated output of 460 watts, designed specifically for use on sloped roofs. The solar electric modules were installed at the same angle as the roof slope to produce an attractive configuration, flush with the existing structure. This system also includes an internet-based monitoring system that records meteorological data and photovoltaic performance.

Ortho-McNeil Pharmaceutical

Neutrogena headquarters in Los Angeles, CA, Ortho-McNeil Pharmaceutical (a Johnson & Johnson company) installed a 75-kW PV array at its facility in Spring House, Pennsylvania. This system will generate about 79,000 kilowatthours per year from 1,750 modules, each with a maximum rated output of 43 watts. As an extra bonus, the 17,500-sq.-ft. roof system provides R-20 value thermal insulation to decrease building energy consumption and reduce heating and air-conditioning costs.

This lightweight BIPV system was installed over the existing roof membrane on the Ortho-McNeil Pharmaceutical research facility. The output from the PV system is connected to the building's service panel.

Tools for Easy Solar Education Outreach

By Jane Weissman

Preparing a presentation to encourage solar energy in schools, learning about solar security issues, and finding incentives for using renewable energy have become easier with several tools developed by the Interstate Renewable Energy Council (IREC).

The Schools Going Solar Workshop-in-a-Box is a collection of tools and information to encourage using solar energy in the schools in a community. The Box contains videos, CDs, and brochures about using solar energy in schools, curriculum implementation, and solar learning activities for the classroom. Cleaner Environment,

- Solar for Traffic Safety,
- Solar for Safer Public Buildings,
- Solar for a Safer Energy Supply, and

■ Solar for Disaster and Preparedness.

"The goal of the campaign is to reach out to groups that aren't part of our solar family like firefighters and police—and help them realize that solar energy has great applicability to the work they do," said Jane Pulaski, IREC's Program Manager for the campaign.

Also, after a recent facelift, the web-based Database of State

silver certificate for Leadership in Energy and Environmental Design els also reduce heating and air conditioning costs due to their in-

Following up on its success with a solar installation at its



The success of the photovoltaic system at Neutrogena headquarters in Los Angeles, Calif., prompted Ortho-McNeil Pharmaceuticals to install this 75-kW array at its facility in Spring House, Pa.

IREC hopes that use of its Workshop-in-a-Box will help provide accurate information on solar energy in a way that stimulates interest in adding solar energy to school buildings and curricula.

In response to safety and security issues, IREC-in collaboration with the U.S. Department of Energy, National Renewable Energy Laboratory, American Solar Energy Society, SEPA, and the Solar Energy Industries Association-has recently launched the Solar Means Safety educational campaign designed to help consumers and businesses use solar energy as a solution to our nation's energy problems. The campaign features a packaged series of fact sheets describing solar power's versatility and flexibility for a variety of uses: ■ Solar for Safer Air and a Incentives for Renewable Energy (DSIRE) has been relaunched. DSIRE's homepage features an interactive U.S. map that allows users to access a list of statespecific incentives with links to program details, relevant legislation, and contact information. The page features searching functions as well as heavily trafficked, color-coded summary maps detailing which states offer certain financial incentives or applicable regulatory policies. Currently, incentives are offered from a variety of sources including the Internal Revenue Service, the U.S. Environmental Protection Agency, and the U.S. Department of Energy.

Jane Weissman is the Executive Director at the Interstate Renewable Energy Council located in Boston, Mass. Tel: 617.323.7377.

Illinois Highlights the PV Industry

The state of Illinois, the city of Chicago, and local enterprises have made significant moves to expand their renewable energy capacities, winning awards for their efforts. In fact, many observers believe these players are proving to be some of the heartiest endorsers of renewable energy technologies.

City of Chicago

The city of Chicago, Illinois, is engaged in one of the most promising strategies. The Chicago Climate Exchange uses traditional business techniques to curb pollution and highlight the benefits of solar power technologies. See their website at <u>www.chicagoclimatex.com</u> (see related article on international affairs on page 13).

On 16 July 2002, the city of Chicago partnership was recognized with a Million Solar Roofs (MSR) Regional Best Progress award for installing more than 500 kilowatts of solar modules in the metropolitan area. The MSR award is a new award recently introduced to recognize partnerships for their achievements in meeting their committed installation goals. A total of six awards were presented to winning partnerships in each of the six U.S. Department of Energy regions.

In October 2002, the Chicago Solar Partnership website, <u>www.ChicagoSolarPartnership.org</u>, which provides solar and other renewable energy information, was awarded as an "Outstanding Website" by the 2002 Web Marketing Association.

State of Illinois

A second MSR award was presented to the partnership comprised of the State of Illinois' Department of Commerce and Community Affairs (DCCA) and the National Energy Education Project for its "Illinois Schools Going Solar" Program. The annual award, presented by the Interstate Renewable Energy Council, recognizes state and local government and schools (K-12) that have implemented innovative projects during the previous year that promote and accelerate the adoption of renewable energy technologies.

More than six schools have received solar installations un-



Spire Solar Chicago has installed the first photovoltaic system larger than 100 kW in the Midwest on the roof of the Art Institute of Chicago.

tional 10 to 25 planned for 2002-2003. The program is funded by DCCA with support from ComEd, BP Solar, Spire Corporation, and ASE Americas, Inc.

Commonwealth Edison

One of the largest energy utilities in the nation, Commonwealth Edison has taken strong efforts to support renewable energy. In conjunction with the city of Chicago, ComEd has committed \$12 million for the purchase and installation of photovoltaic power systems. According to Gabriela Martin, Manager of Environmental Commitments with ComEd, this effort has involved a series of installations, including the following projects in Chicago:

■ A PV system was installed at the ComEd Chicago North Commercial Center, one of the utility's oldest facilities. The 25.2kW system was installed by Spire Solar Chicago. Since the facility serves as a primary customer service call center and houses other operations, seven days per week, and requires a continuous electrical power.

Four hundred and eight PV modules produce a total of 49 kW at the Field Museum of Natural History. This system generates 53,200 kWh per year. ■ The Frank W. Reilly Elementary School now generates 11,130 kWh per year with 136 modules producing a total of 10.2 kW. This facility became the first Chicago public school to have PV installed on its roof back in 1999. Students at Reilly learn about alternative sources of energy, such as solar, as part of an innovative environmental education program at the school.

■ At the Art Institute of Chicago, 492 PV modules, rated at 103.6 kW, have been installed on the roof. This system includes three 15-kWac inverters and has an estimated annual output of 56,357 kWh. The Art Institute is a world-class facility, which gives this system especially high visibility.

In addition to the \$12 million

Architects Have New Tool to Design Energy-Efficient Buildings

Energy-10 is a PC-based building design tool that complements the standard architectural design process and helps architects identify cost-effective ways to create energy-efficient buildings.

Originally written by the U.S. National Renewable Energy Laboratory (NREL), Lawrence Berkeley National Laboratory and the Sustainable Building Industries Council (SBIC), the software allows building designers to calculate simplified lifecycle cost parameters, such as initial construction, mortgage, taxes, HVAC, energy efficiencies, fuels, and maintenance expenses. The current version of Energy 10, however, Version 1.5, does not include the incorporation of PV.

To remedy this, in summer 2002, programmers, architects, and other users met outside Washington, D.C., to discuss the next generation of Energy-10, Version 2.0. As currently planned, the upgraded program will be released in early 2003 and include PV simulation capacity, three-dimensional building design sketch capacity, and LEEDTM building efficiency ratings calculations.

The new features will further distinguish Version 2.0 from similar building design programs. The PV simulation feature, for instance, will allow designers to incorporate PV systems into early design plans and determine how these renewable energy systems will affect overall building performance. This new feature will help designers determine how PV will affect electricity generation and subsequent total energy costs.

Also, architects will be able to use Version 2.0 to design threedimensional buildings of any size, including structures up to 100,000 square feet and larger.

"I have been looking forward to seeing the 3-D design capacity," said Bill Bobehausen, with the Sustainable Design Collaborative. "These added sketch features will let Energy-10 users break out of the current two-dimensional shoebox mode and go one step further."

Version 1.5 of Energy-10 is currently available. Programmers

ciency mechanical systems, and other features of commercial and institutional buildings comprising less than 10,000 square feet. These buildings would typically have two thermal zones and might include schools, libraries, small banks, stores, restaurants, offices, and low-rise residential structures.

Best Used During Pre-Design

To create a building that suits client needs, building designers can get the best use from Energy-10 during the pre-design and preliminary design architectural phases.

The currently available Version 1.5 can configure building descriptions. With the automatic building generation wizard, AutoBuild, a reference case building can be designed with five general characteristics: utility rates, location, building use category, size, and HVAC configuration. Programmers have loaded Energy-10 with default values based on national averages for various building types.

Other features can apply energy-efficiency strategies, run weather simulations, rank energy saving variables, and retain different configurations for future modifications. Version 2.0 will show the impact of including passive solar heating, insulation, energy-efficient lighting, daylighting, and extra mass for heat storage. Also, with weather data compiled for a building area, building simulations can calculate distinct hourby-hour building performances throughout a calendar year. These data help identify the most significant energy issues and the effectiveness of the selected strategies.

The ability to modify design specifications and experiment with new ideas in Energy-10 has the potential to revolutionize the way energy-efficient technologies like PV are used by today's architects. And, when it is released, the software's Version 2.0 will make it easier for a designer to maximize the benefits of solar electric power.

For further information, SBIC offers "Designing Low-Energy Buildings" workshops for Energy-10 software and implementing other energy saving techniques. See <u>www.SBICouncil.org</u> for further details.

der this program, with an addi- it operates 24 hours per day,



Students and faculty inspect the 10.2-kW photovoltaic system installed on the roof of the Reilly Elementary Chicago Public School. The photovoltaic system is part of a curriculum that teaches students about alternative energy and the environment. allocated for PV purchasing and installation, ComEd has provided \$225 million in start-up capital to finance renewable, efficiency, and other environmental projects in the Illinois Clean Energy Community Trust.

The utility also offers customers the opportunity to participate in its Wind and Photovoltaic Generation Pricing Experiment, a program designed to encourage the residential and business use of renewable energy technologies. This interconnection program is offered to ComEd retail customers which own and operate small (under 40 kW), onsite wind generators or photovoltaic systems. ComEd pays participants annually for at least five years in return for allowing the utility to track electricity generated.

from NREL and SBIC initially wrote this software to calculate solar heating, daylighting, high-effi-

Energy is What Counts

(continued from page 2)

kilowatt-hours is the true measure of the amount of energy produced and benefit to the environment, not installed kilowatts, so System A is actually the more effective system.

When you're looking into buying a solar PV system, ask how much electricity will flow into your home or business, then ask what can be done, if anything, to get more kilowatt-*hours* out of the system. As a start, a few ideas for generating more energy are to increase the panel's tilt angle (the angle from horizontal should be roughly equal in degrees to your latitude), increase natural air-flow around the panels (a cooler solar panel makes more power!), and, if possible, face the panels due south. Ask your solar energy professional for their ideas.

The amount of solar energy flowing into your home or business is the true measure of the effectiveness of your PV system, energy savings, and positive impact on the environment. And that's where solar PV works its magic.

Tom Hunton is the Director of Marketing and Sales with RWE Schott Solar, located in Billerica, Mass. Tel: 978.947.5918.

Solar Electric Business Directory

ENERGY SERVICE PROVIDERS

Alabama Power Company

www.alabamapower.com Dr. Douglas M. Boylan Phone: 205.257.6917 Fax: 205.257.5367 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

Ms. Meredith Owens Phone: 510.748.3946 Fax: 510.814.5699 Email: mowens@alamedapt.com 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 Ms. Rebbeca Blood Phone: 202.467.2929 Fax: 202.467.2910 Email: rblood@appanet.com The APPA 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

Ms. Romi Carrell Phone: 520.547.7910 Fax: 520.547.7910 Email: rcarrel@aepnet.rg 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.

Ashland Department of Electric Utilities (Oregon)

www.ashland.or.us Mr. Dick Wanderscheid Phone: 541.522.2061 Fax: 541.488.5311 Email: dick@ashland.or.us 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. Phone: 246.430.4400 Fax: 246.426.6000 Email: Peter.williams@blpc.com.bb

Bowling Green Municipal Utilities (Ohio)

www.bgohio.org/public-utilities.htm Mr. Daryl Stockburger Phone: 419.354.6246 Fax: 419.959.4763 Email: bgmundir@wcnet.org

Braintree Electric Light Dept. (Massachusetts) www.beld.com

Mr. Kenneth E. Stone

Phone: 781.348.1031 Fax: 781.348.1003 Email: kstone@beld.com 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.

Citizens Utilities Company (Arizona)

www.czn.com Ms. Maryann Shepherd Phone: 520.753.0202 Fax: 520.753.4006 Email: msheper@czn.com

City of Westerville (Ohio)

www.ci.westerville.oh.us Mr. Andrew Baotright Phone: 614901.6703 Fax: 614.901.6731 Email: aboatright@ci.westerville.oh.is The City of Westerville Electric Division (WED) has been actively involved in energy education initiatives through its financial and in-kind support of 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.

Clallam County PUD (Washington)

www.clallampud.net

Mr. Dave Johnson Phone: 360.565.3253 Fax: 360.452.9724 Email: davej@callampud.net

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.

Colton Electric Utility (California) www.ci.colton.ca.us

A solar electric system at the city of Colton's Public Works Administration Building acts as a 120-foot-long carport. Colton Electric Utility dedicated the facility in July 2000. At the same time, the city sponsored a solar energy and electric vehicle expo to inform residents about the benefits of clean energy technologies. several partnership PV system installations.

CSG Services (Texas)

www.csgrp.com Mr. John E. Hoffner Phone: 512.327.6830 Fax: 512.327.2553 Email: john.hoffner@csgrp.com 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)

www.detroitedison.com Mr. Norman J. Stevens Phone: 313.235.9462 Fax: 313.235.0285 Email: stevensn@dteenergy.com DTE Energy's principal operating subsidiary is Detroit Edison, which has two solar facilities in its service area under its awarding-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 gridconnected PV systems.

Electricité de France (France)

www.edf.fr Mr. Robert Soler Phone: + 33 147653327 Fax: + 33 1476532198

Email: Robert.solar@edf.fr

EDF has developed an international strategy based on investment and the sale of services. The company relies on partnerships with electrical utilities, manufacturers and investors, and is now present in a wide range of foreign companies. Outside France, Electricité de France is involved in the construction or operation of generating facilities with an installed capacity of 23,000 MW and supplies power to 17 million customers. 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 programme, 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

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 http://www.epri.com/destinations/.

Elektrizitätswerk der Stadt Zürich (ewz) (Switzerland)

www.ewz.ch

Mr. Bruno Huerlimann Phone: 411.319.4151 Fax: 411.319.4180 Email: bruno.huerlimann@ewz.stzh.ch 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.

FirstEnergy

www.firstenergycorp.com Ms. Eva Gardow Phone: 973.401.8374 Fax: 973.644.4277 Email: egardow@gpu.com FirstEnergy, 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 Ms. Susan R. Schumann Phone: 407.355.7767 Fax: 407.856.6553 Email: susan.schumann@fmpa.com 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 Dr. Douglas M. Boylan Phone: 205.257.6917 Fax: 205.257.5367 Email: dmboylan@southernco.com

Gulf Power Company (Florida)

www.gulfpower.com Mr. Brian Gautier Phone: 850.444.6369 Fax: 850.444.6237 Email: bigautie@southerco.com 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 form customers interested in renewable energy and/or helping to improve the quality of Gulf Power Company service area schools.

Austin Energy (Texas)

www.austinenergy.com Ms. Leslie Libby Phone: 512.322.6290 Fax: 512.322.6083 Email: libby@electric.austin.tx.us Austin Energy, the municipal utility in the capitol of Texas, has long been a supporter of PV and other technologies that protect the environment. The 24 systems in its territory represent 192 kW of PV. Two additional systems will be installed in 2002 adding 11kW of capacity. The newest installation in Austin will be a building integrated 8kW system at the Austin Convention Center.

Barbados Light & Power Company (Barbados) www.blpc.com.bb Mr. Peter W.B. Williams

Commonwealth Edison Company (Illinois) www.ceco.com or

www.chicagosolarpartnership.org Ms. Gabriela Martin

Phone: 312.394.2354 Fax: 312.394.4466 Email: Gabriela.martin@execloncorp.com 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. Under the umbrella of the Chicago Solar Partnership, ComEd and it's partners have developed a website that provides resources for customers and teachers and real-time data displays for

participated in the construction of a 50 MW wind farm at Koudia al Baïda, Morocco.

Edison Electric Institute (Washington, D.C.) www.eei.org

Mr. Charles W. Linderman

Phone: 202.508.5652 Fax: 202.508.5600 Email: clinderman@eei.org

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 netmetering.

Electric Power Research Institute (California) www.epri.com

Dr. Terry Peterson

Phone: 650.855.2594 Fax: 650.855.2594 Email: tpeterson@epri.com

EPRI, the Electric Power Research Institute, headquartered in Palo Atlo was established in 1973 as a center for public interest energy and environmental research. EPRI's collaborative science and technology development program

Hawaii Electric Light Company, Inc. www.hei.com Mr. Patrick Moore Phone: 808.969.0136 Fax: 808.969.7253 Email: pmoore@hei.com Over 28% of Hawaii Electric Light Company's power is generated from renewable resources. 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 2400 solar water heating systems have been installed under a utility rebate program and three schools have had PV 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.

Hawaiian Electric Company, Inc. www.heco.com Mr. Arthur Seki

Phone: 808.543.7987 Fax: 808.543.7519 Email: aseki@hei.com

Hawaiian Electric Company, Hawaii Electric Light Company and Maui Electric Company (the HEI family of companies) have installed solar electric installations at several public schools on Oahu, the Big Island and in Maui County. They also operate and maintain the solar equipment, and help develop related educational curriculum.

Indianapolis Power & Light Company (Indiana) www.ipalco.com

Mr. Daniel B. Melvin Phone: 317.261.8504 Fax: 317.630.5632 Email: dan.melvin@aes.com

JEA (Florida)

www.jea.com

Ms. Susan N. Hughes Phone: 904.655.6248 Fax: 904.665.7376 Email: hughsn@jea.com

JEA, the public utility for the greater Jacksonville, Florida area, has become the largest user of gridtied 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. The latest installation provides electricity as well as needed shading to the giraffes at the Jacksonville Zoo.

Kansas City Power and Light (Missouri)

www.kcpl.com Mr. George Mentrup Phone: 816.654.1667 Fax: 816.556.2884 Email: George.Mentrup@kcpl.com

Long Island Power Authority (New York) www.lipower.org/solar

Ms. Diane Blankenhorn

Phone: 516.545.3135 Fax: 516.545.5248 Email: dblankenhorn@keyspanenergy.com 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

Ms. Angelina Galiteva Phone: 213.367.1577 Fax: 213.367.3202 Email: Angelina.Galiteva@ladwp.com 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

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 Zelingher Phone: 914.287.3824 Fax: 914.681.6860 Email: shalom.zelingher@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: gibsorj@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

844.2186

Solar Electric Business Directory

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.

Palo Alto Electric Utility (California)

www.city.palo-alto.ca.us

Ms. Lindsay Joye Phone: 650.329.2680 Fax: 650.617.3140 Email: lindsay_joye@city.palo-alto.ca.us 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 http://www.cpa.com/programs/pvpartners/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 15 to 20 years.

Public Service Company of New Mexico www.pnm.com

Ms. Toni Rista Phone: 505.241.2015 Fax: 505.241.2355 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 Phone: 916.732.6813 Fax: 916.732.6563

Email: pbender@smud.org

SMUD began its solar leadership role in the late 1980's when very few energy service providers had any experience in photovoltaics. Through SMUD's efforts over the past two decades, the cost of solar electricity to SMUD customers has been slashed 6-fold. More than eight hundred 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: Ibrown@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 offers its residential customers a rebate on purchase and installation costs of new PV systems. Currently, SVP assists its customers in receiving the \$4.50 per output watt buydown

sion. Socorro Electric Cooperative (New Mexico)

available through the California Energy Commis-

www.socorroelectric.com Mr. Guadalupe Vega

Phone: 505.835.0560 Fax: 505.835.4449 Email: lupe@sorroelectric.com

Soluz, Inc. (Massachusetts)

www.soluz.net Mr. Richard D. Hansen Phone: 978.251.8387 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 Fax: 205.992.5103

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 F.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

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) www.mge.com Ms. Laura Williams Phone: 608.252.7131 Fax: 608.252.4734 Email: Iwilliams@mge.com Madison Cas & Electric (MGE) owns and operate

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

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 (North-

west) 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 Ms. Annemarie Goedmakers Phone: +31.26. 844.2143 Fax: +31.26. solar electric systems are now providing clean power for thousands of customers in the greater Sacramento area, totaling over 10 megawatts of PV.

Salt River Project (Arizona)

www.srpnet.com Ms. Ethel Dearr

Phone: 602.236.2045 Fax: 602.236.3407 Email: erdemarr@srpnet.com

Salt River Project (SRP) provides its customers with renewable energy through its EarthWise Energy program. Solar power is provided to the program through two 200kW PV power plants. SRP is also currently testing the use of five different residential PV power systems for use in new home construction. SRP plans to build a 100kW PV power system at a City of Phoenix Park & Ride facility and a 25kW covered parking facility at the City of Mesa Regional Library.

San Francisco Public Utilities Commission (California)

www.ci.sf.ca.us/puc Mr. William G. Peden Phone: 415.554.0777 Fax: 415.554.3161 Email: wpenden@puc.sf.ca.us 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: 508.836.3138x3221 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 a 18kW system

Taunton Municipal Lighting Plant (Massachusetts)

at the Capital Center Office Complex.

www.tmlp.com Mr. R. Scott Whittemore Phone: 508.824.3128 Fax: 508.823.6931 Email: scottwhittemore@tmlp.com

Tennessee Valley Authority

www.tva.gov

Ms. Rita Livezey Phone: 423.751.8027 Fax: 423.751.6087 Email: rjliveezey@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.

Tri-State G&T Association www.tristategt.org

Mr. Arthur Mander

Phone: 303.452.6111 Fax: 303.254.6068 Email: artman@tristategt.gov

Tri-State G&T is a wholesale supplier of electricity to 44 member distribution systems throughout Colorado, Nebraska, New Mexico and Wyoming. Tri-State kicked off its green power program in 2002 when it started providing wind generation to nearly half of its member systems. Under the voluntary renewable resource program, which was approved by the Tri-State board in 1998, the association's member systems have been offered the opportunity to purchase energy blocks of renewable power.

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

Mr. Bill Henry Phone: 520.745.3251 Email: bhenry@tucsonelectric.com Tucson Electric Power Company's (TEP) combined solar operations, which includes 315 kW in Tucson and a 2.4 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 in 2003.

TXU (Texas)

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

Vectren Corporation

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

We Energies (Wisconsin)

installed. Wisconsin Public Service Corporation is

also assisting the University of Wisconsin-Green

120,000 square foot classroom building on its

installed a 12-kilowatt solar power plant at its

PV MANUFACTURERS,

DISTRIBUTORS, AND

INSTALLERS

Phone: 907.562.4949 Fax: 907.563.4900

Anchorage subsidiary, Alaska Battery Mfg., are a

Alpha Technologies is an established, value-added

integrator of photovoltaic and ther distributed

generation DG) power systems for residential,

small commercial and institutional applications.

The company has in recent years emerged as a

technology market innovator, helping manufac-

tures, electric utilities and other organizations to

take a leadership role in the growing DG industry.

Alpha's sate of the art photovoltaics (PV) systems

makes it easy for homeowners and businesses to

service approach to PV makes it easy for anyone

to convert sunshine into free solar electricity .

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electricity. Amonix's IHCPV systems are ideal for

centralized "solar farm" power applications or for

electrification. IHCPV technology is a nonpollut-

ing, efficient, and reliable power source for the

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Headquartered in Newark, Delaware, AstroPower

Amonix, Inc. is a privately held designer and

manufacturer of proprietary, patented high-

generating systems that convert sunlight to

performance photovoltaic solar cells and

distributed applications including village

AstroPower, Inc. (Delaware)

Email: hwenger@astropower.com

www.astropower.com

Mr. Howard J. Wenger

enjoy clean reliable, solar electricity. Alpha's full

major source in Alaska for batteries, alternative

energy and remote or mobile power products.

Founded in 1988, ABS Alaskan, Inc. and its

Bay in integrating 23 kilowatts of building

integrated photovoltaics (BIPV) into a new

campus. In 1993, Wisconsin Public Service

Green Bay service center.

ABS Alaskan (Alaska)

Email: dalanda@absak.com

Alpha Technolgies(Colorado)

Email: kstokes@alpha.com

Visit us at www.alpha.com

Alten Energy (California)

Email: avi@altenenergy.com

Amonix, Inc. (California)

Mr. Vahan Garboushian

Email: vahan@amonix.com

www.amonix.com

future.

www.altenenergy.com

Mr. Avi Alcaly

Phone: 303.277.0025x102 Fax:

www.absak.com

www.apha.com

Mr. Kirk Stokes

303.277.0029

Ms. Dalanda Eppley

BP Solar (Maryland) www.bpsolar.com

Mr. Todd Foley

Phone: 410.981.0253 Fax: 410.981.0278 Email: foleymt@bpsolar.com 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.

Colco Electric Company Limited (Bahamas) Mr. Timothy Collie

Phone: 242.393.4323 Fax: 242.393.4328 Email: colcoe@coralwave.com Colco Electric Company Limited, a family owned business, has been the authorized Siemens distributor for Energy and Automation in the Bahamas since 1996. Colco Electric provides electrical engineering and related construction services for individual and corporate clients. Presently Colco Electric is concentrating heavily on electrifying sub-divisions, street lighting and the use of alternative energy.

EBARA Solar, Inc. (Pennsylvania)

www.ebarasolar.com

Mr. Richard Rosey Phone: 724.379.2001 Fax: 724.379.4028 Email: rrosey@ebarasolar.com EBARA Solar offers a full range of "standard" photovoltaic modules. These standard modules utilize time-proven materials that provide longterm, stable, module performance. In addition to the "standard" modules, EBARA Solar can provide custom-sized cells, laminates or modules.

EcoEnergies (California)

www.ecoenergies.com Dr. William R. Bottenberg Phone: 408.731.1207 Fax: 408.746.3890 mail: wbottenberg@ecoenergies.com 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

Mr. Mark Farber Phone: 508.357.2221 Fax: 508.357.2279 Email: Farber@evergreensolar.com 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)

Phone: 781.749.9593 Fax: 781.749.3406 Email: Chandleman@heliotronics.com Heliotronics, Inc. designs, sells, markets and promotes innovative ideas and products that accelerate the adoption of utility grid connected photovoltaics. Heliotronics has expertise in data acquisition, grid connected inverters and other electronic products that serve the distributed generation industry.

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

Mr. Sass Peress Phone: 514.270.57700x105 Fax: 514.270.3677 Email: speress@icpglobal.com 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 Phone: 808/523-0711 Fax: 317.630.5632 Email: hschkabla@ipalco.com Inter-Island Solar Supply (IISS) is one of the nation's largest distributors of renewable energy products and packaged systems. IISS 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 Mr. Cecilia Aquillon Phone: 480.443.7956 Fax: 480.483.2986 Email: Caguillon@kyocerasolar.com 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 Mr. Joe Bendrick Phone: 831.430.9272 Fax: 831.430.9278 Email: josefb@multi-contact-usa.com 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.

OutbackPower Systems (Washington)

www.we-energies.com Mr. Carl Siegrist Phone: 414.221.2183 Fax: 414.221.3990 Email: Carl.Siegrist@we-energies.com

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.

Wisconsin Public Service Corporation www.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 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.

Bekaert ECD Solar Systems LLC (California) www.uni-solar.com Mr. Mario Hertegonne

Phone: 248.475.0100 Fax: 248.364.0510 Email: Mhertegonne@uni-solar.com United Solar produces thin-film amorphous photovoltaics. United Solar and ECD have pioneered, developed and hold basic patents covering the continuous roll-to-roll manufacturing of thin-film amorphous silicon alloy multijunction solar cells and related products. United Solar and Bekaert ECD offer a line of solar electric roofing panels, which are unique, flexible, www.firstsolar.com Mr. Mike Ahearn

Phone: 602.414.9300 Fax: 602.414.9300 Email: mahearn@firstsolar.com 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, Inc (Arizona) www.globalsolar.com

Mr. Scott L. Kaminky

Phone: 303.583.7252 Fax: 303.583.7253 Email: skaminky@globalsolar.com

Global Solar Energy, Inc is a manufacturer of thinfilm Copper-Indiun-Gallium-diSelendie(CIGS) photovoltaic (PV) cells, modules and systems. Global Solar also designs, installs, commissions and services complete turnkey solar PV power stations utlizing various commercially available PV module technologies, including one of the worlds largest grid-tied systems at 2.4 MW in Springerville, Arizona.

Heliotronics, Inc. (Massachusetts) www.heliotronics.com Mr. Clayton Handleman www.outbackpower.com Mr. Christopher Freitas Phone: 360.435.6030 Fax: 360.435.6019 Email: cfreitas@outbackpower.com

Pacific Solar Company (California) www.pacificsolar.com Mr. Maurice Miller Phone: 415.221.9909 Fax: 415.876.1510 Email:mmiller@pacificsolar.com

Pacific Solar Pty. Limited (Australia) www.pacificsolar.com.au Mr. Peter Lawley Phone: 612.931.66811 Fax: 612.966.64079 Email: peterl@psolar.com.au 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 marking 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 Sun*E*mpower[™] in the USA. It allows

homeowners to power-up their homes with clean, green electricity made from the sunlight falling on their roofs.

Phasor Energy Company (Arizona) Mr. Thomas Lepley

Phone: 602.765.4467 Fax: 602.404.1765 Email: tlepley@aol.com

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

Phone: 510.540.0550 Fax: 510.540.0552 Email: dshugar@powerlight.com 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 U.S.

ProVision Technologies (Hawaii) www.provisiontechnologies.com

Mr. Steve Burns

Phone: 808.969.3281 Fax: 808.934.7462 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, Inc. (Massachusetts)

www.asepv.com Mr. Tom Hunton

Phone: 978.947.5918 Fax: 978.663.2868 Email: thunton@asepv.com

RWE Schott Solar's solar electric products provide decades of clean, reliable electricity for businesses, homes, energy service providers, and many other applications. RWE Schott Solar manufactures the world's most powerful solar electric module, the ASE 300. RWE Schott Solar belongs to the RWE Solutions group, a supplier of integrated technical systems and services focusing on the energy sector.

SatCon Power Systems (Ontario, Canada) www.satcon.com Mr. Clemens Van Zeyl 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 environmen-

tally responsive building design. The firm offers a

wide diversity of services to private, commercial,

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commitment to excellence and are making strides

improvements in crystalline silicon photovoltaic. In

modules called HIT Power 21 [™] (Heterojunction

lighting systems worldwide, as well as thousands

of highway emergency call boxes, road signs and

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Spire, founded in 1969, is the world's largest

to date supplying over 144 facilities in 42

supplier of PV module manufacturing equipment,

countries. Approximately 90% of PV modules in

use today were manufactured in part with Spire

equipment. Recently, Spire has taken a leadership

formulate an innovative approach addressing the

role in partnership with other organizations to

development of brownfields into brightfields,

manufacturing and power-producing facilities.

Through this concept, Spire promotes the use of

Phone: 815.256.2222 Fax: 818.256.2221

SunWize Technologies specializes in the design

distribution. SunWize's experience includes value-

and manufacture of integrated solar power

systems, project development and product

added system integration and utility grid-tied

industries including telecommunications, traffic

government agencies, and the military. SunWize

established Solar Connect™ residential grid-tied

programs in New York and Illinois in 2000 and is

implementing the program nationwide. SunWize

provides green credit program services. SunWize

offers products and construction management

services for commercial grid-tied applications.

Through strategic partners, SunWize also

collaborates with finance specialists to make

businesses and government entities.

TerraSolar (New York)

www.terrasolar.com

funding available to homeowners, commercial

safety, oil and gas, utilities, state and federal

systems working with customers in many

through the establishment of on-site PV

clean energy, revitalizes brownfields, and

contributes to new local job creation.

SunWize Technologies

Email: mwwpv@stelle.net

www.SunWize.com

Mr. Mark Wilkerson

industry. Solec is a pioneer in developing major

1997, SANYO introduced new PV cells and

with Intrinsic Thin Layer). HIT systems power

Spire Corporation (Massachusetts)

Email: shogan@spirecorp.com

In 1994, Solec combined forces with Sanyo

Electric in Japan. Both companies share a

toward improvements in the solar energy

research, and utility clients.

www.solecsolar.com

Mr. Jawid Shahryar

traffic signals.

www.spirecorp.com

Mr.Stephen J. Hogan

Solec International, Inc. (California)

Email: jshahryar@solecintl.com

steel. All fasteners are stainless steel. UniRac addresses code compliance, and all products are shippable via UPS.

Vanner Power Group (Ohio) www.vanner.com

Mr. Dave Rhodes Phone: 209.725.1747 Fax: 209.725.1748 Email: acpower@cell2000.net Vanner is a manufacturer of DC to AC power inverters, battery monitors, battery chargers and other power conversion products. Its products are used in applications such as utility vehicles, emergency vehicles, motor coaches and transit buses, recreational vehicles, marine vessels, alternative and renewable energy systems, and utility, telecom and UPS battery backup sites.

Xantrex Technology (British Columbia, Canada) www.xantrex.com

Mr. Kevin Hagen Phone: 360.435.8826, x2008 Fax: 360.435.3547 Email: khagen@traceengineering.com 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 elcetrical energy from any source such as solar, wind, or microhydro, into high-quality household power. More than 200,000 homes and businesses rely on Xantex power electronics to bring them electrcity anytime, anywhere. Xantrex products allow customers around the world to increase energy efficiency and freedom, while making a positive impact on the environment.

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Interstate Renewable Energy Council (Massachusetts) www.irecusa.org Ms_lane M_Weissman manufactures, investors and developers, energy end users, and government agencies are turning NCI to help them understand how to create vale 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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Mr. Steve Kalland Phone: 919.513.1896 Fax: 919.515.5778 Email: steve_kalland@ncsu.edu 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 the of 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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Schott Applied Power (California) www.us.schott.com/apc Mr. Thomas J. Starrs Phone: 916.415.9921 Fax: 916.415.9987 Email: tom.starrs@us.schott.com Schott Applied Power Corporation is a photovoltaic distributor and complete systems provider. SAPC and its partners bring clean energy to businesses, utilities homeowners, and governments worldwide.

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Solar Design Associates (Massachusetts) www.solardesign.com Mr. Steven Strong Phone: 978.456.6855 Fax:978.456.3030 Email:sjstrong@solardesign.com Solar Design Associates (SDA) is a group of architects and engineers dedicated to the design Mr. John Siciliani Phone: 718.422.0100 Email: j.siciliani@terrasolar.com TerraSolar, Inc. develops, manufactures and markets solar power products for distributed residential, commercial, and industrial markets. TerraSolar products are used for various applications: to supply backup power for homes, to offset expensive daytime power for commercial businesses, to supply large utility-scale peakpower production, and for village electrification and water pumping in the developing world.

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UniRac, Inc. is the manufacturer of a comprehensive line of photovoltaic mounting racks, including an installation-friendly SolarMount universal roof mounting system. Many of UniRac's products, including large array ground mounts, now utilize SolarMount rails. Trackers plus roof, ground, pole top, side of pole, and RV mount models are available. UniRacs fit all major PV module brands and employ aluminum and/or Grade 5 zinc plated Phone: 617.323.7377 Fax: 617.325.6738 Email: weissmanpv@aol.com

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Solar Electric Power Association

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

Solar Power Solutions Addressing the Barriers to Commercialization

The final results are in from Solar Power Solutions (SPS), a U.S. Department of Energy-funded, SEPA-managed commercialization effort. SPS started in 2001 and included a detailed market and technology analysis and funding for two showcase projects. SEPA issued its report, A Business Case for Capturing Total Value, in early 2002. The two showcase projects were completed in the fall of 2002.

The Business Case report identifies six factors (see sidebar) that will lead to the successful commercialization of solar electric power. The two showcase projects were competitively selected because each addressed these factors in ways that could easily be replicated.

The two recipients of the SPS award, the City of Tucson (in partnership with Tucson Water and Tucson Electric Power) and EcoVillage Cleveland, each received funding awards of \$75,000 for their projects. Both projects

take unique, replicable, approaches to accelerate the acceptance and deployment of PV, demonstrate new avenues and applications for successful PV technology deployment, and reveal the business, economic, and environmental benefits of solar.

Reaching Out in Tucson

The Tucson partnership installed two 20-kW groundmounted photovoltaic systems in August 2002 at the Hayden/Udall Water Treatment Facility. Beyond these simple installations, however, the partners also developed an outreach program targeted at Arizona utilities, cities, and municipalities to facilitate information exchange and provide training to local PV installers and electricians. The system designs used by Tucson are also available to other utilities or municipalities, and can easily be adjusted to accommodate differently shaped land areas.

Vincent Hunt, Energy Man-



These two 20-kW arrays installed by Global Solar are located at the Hayden/Udall Water Treatment Facility in Tucson, Arizona.



AstroPower provided the PV systems for the EcoVillage Cleveland project. The systems were installed on the garages of the town homes. Because the homes are energy efficient the PV system will provide almost one hundred percent of their energy needs.

ager at the City of Tucson, attributes the success of this project to "excellent cooperation between public and private entities, and a strong dedication by everyone involved."

The City of Tucson expects to save more than \$3,000 annually in electric bills from the Hayden/ Udall facility as well as benefit from a more reliable source of power in the event of an emergency. The new PV system will produce an estimated 72,300 kWh annually.

Developing PV in Townhouses

The EcoVillage Cleveland is a new, environmentally sustainable, 20-unit town home development. The original plans for the development did not include PV; they did, however, incorporate energyefficient technologies. With the SPS funding, the project leader, the Detroit Shoreway Community De-

velopment Organization (DSCDO), decided to include AstroPower photovoltaic systems on four of the homes. The other 16 homes in the development can all accommodate PV systems and the option of adding a PV system is available to all homebuyers.

Green Energy Ohio's annual Solar Homes Tour featured the four EcoVillage homes. Additionally, there have been a number of tours for perspective homebuyers and other interested parties. An important component of the EcoVillage project is the involvement of a number of community organizations and state and federal government agencies. The DSCDO is investigating opportunities for other environmentally sound developments and will continue to offer solar as an option for the new

homes. systems in new home construction. SRP is working with a particular builder, Calex, at their Johnson Ranch/Queen Creek community. The residential project involves several PV manufacturers, including: Schott Applied Power, and BP Solar. The project will be completed in November 2002; however, they have already received some preliminary results.

Fall 2002

7

Critical Success Factors for PV Market **Development**

Excerpted from: Solar Power Solutions: A Business Case for Capturing Total Value

Technology Development

Customer needs must be understood, and the elements of the PV technology must be fully developed and ready to cost-effectively meet those needs. PV is currently ready to provide grid-connected distributed generation across the U.S.; further research will bring down costs, improve efficiencies, and improve inverter performance, but the current technology is viable.

State and Federal Policies Aligned

The government, at all levels, provides the appropriate mix of incentives, actions to reduce barriers, and procurement to allow PV technology to address target markets. Many states have developed policies for PV, while others are not as far along and would benefit from the lessons of others. Federal policies should serve, among other goals, to support state actions.

Electricity Provider (Utility) Acceptance

The local utility provides cooperation for the end user to insert PV as a seamless addition into the existing power grid. Utility acceptance of PV is a critical factor for market development, as even the highest incentives and most enthusiastic supporters can be stalled by prohibitively difficult requirements.

Downstream Infrastructure

Distribution and service network is sufficiently developed to support PV within the market segment. Any initiative to deploy PV requires locally available PV systems and qualified personnel to install and service them.

Informing the Market The end users and stake-

Salt River Project Expands Solar

Salt River Project (SRP) is in an ideal location to generate solar power and has developed a variety of projects to tap into that powerful Arizona sun. In March 2001, SRP installed a 200-kW solar generating unit at its Agua Fria generating station. There are also two 96-kW PV installations at the Rogers/Santan unit.

In addition to these installed PV units, SRP is using PV for distributed generation and systems on commercial, residential, and school buildings. These are in addition to a number of solar thermal projects.

generation projects are currently underway at SRP. These include two covered parking projects in the SRP service area. In the city of Mesa, Arizona, SRP is installing a PV-covered parking project at its regional library using UniSolar roof laminates. The project should be completed in November 2002 and have a capacity of 25 kilowatts. A second covered parking project will utilize Schott Applied Power's SAPC module for a Park & Ride kW and it is expected to be completed in April 2003.

SRP is currently in the design phase for a roof-mounted, 200-kW PV power system on a warehouse additions in Tempe. Electric power for both the building and facility will be provided by the solar generation. The utility plans to issue a bid for the PV system this fall, with completion scheduled for April 2003. This is the first largescale building PV project that SRP Siemens Solar, Kyocera, Unisolar, They have found that the technology works, although inverter reliability is an issue. And though here has been high customer interest,

Several specific solar electric

facility in Phoenix. The city will lease the canopy space to SRP to mount the PV units and SRP will, in turn, sell Phoenix Green Energy. The capacity for this project is 100 has undertaken.

Another big project for SRP is its Residential PV Demonstration Project, involving the evaluation of five residential PV power



This home is part of SRP's Residential PV Demonstration Project, a partnership between SRP, PV manufacturers, and homebuilder Calex. This project tests several PV technologies incorporated into new homes. there have not been any sales.

Salt River Project has also gotten involved in solar thermal technologies. These projects include the Solar Dish Stirling Demonstration project through the U.S. Department of Energy and SAIC program. Although it is still in the early stages, the plan is for the unit to operate on solar energy as well as landfill gas. Another solar thermal project is underway in collaboration with Sandia National Laboratories. They are in the process of testing and evaluation of a prototype roof-integrated solar water heating technology called Roof Integrated Thermosiphon. The RITH system heats and moves household water without any moving parts. It is integrated into the roof, similar to a skylight.

Salt River Project has clearly seen the tremendous opportunity that it has available from the sun. holders within each market segment are informed of the value proposition of PV. In some cases, PV is cost-effective simply on its energy value; in other cases, the total value proposition makes it the highest-value choice. Informing the market of these benefits will create sustained and growing demand for PV.

Financing Options

Flexible, tailored, and widely-available finance vehicles open the market to more end users. Because of its high up-front cost but very low operation and maintenance costs, PV benefits greatly from the availability of low-cost lowhassle financing options such as mortgage lending or assetbased leasing programs.

The International Solar News

Race to Install PV Systems

In anticipation of electricity price hikes next year due to industry deregulation, South Australians are installing an increasing number of state-of-the-art solar electric systems.

Since the announcement of the government rebate, installation numbers have been climbing, with five installations in May, 12 in June, and 25 at the end of July. In sum, 273 homeowners have installed the one-kilowatt government-approved solar electric systems at a cost of A\$1.78 million in rebates to the South Australian State Government. Each system is eligible for a A\$5,000 rebate.

With the rebate set to expire at the end of 2002, and prices predicted to increase dramatically in 2003 due to deregulation, manufacturers expect system demand to continue to grow.

Community Power Plants in Japan

In Japan, what one might call "community power plants" are on the increase. These are facilities financed jointly by local residents who favor eco-friendly solar power generation but cannot afford millions of yen to install their own PV system on a town unit or do not have homes with roofs suited to solar panel installation.

A unit named Himuka Ichigokun became the first such community power plant built in Kushima, Miyazaki Prefecture, in 1994. About 30 similar units have since sprung up around the nation, reflecting the growing public concern about global warming. Some units rely on wind power, but the great majority are PV power plants with output capacities of around five kilowatts.

In a national forum held recently, residents were surprised to see how producing power increased their sense of environmental responsibility.

"Power generation is really about how best to save power," remarked one participant. "Once you've become a power producer yourself, you realize how important it is to save energy."

Like in many other regions of the world, community power plants experience the frustrating struggle of coping with long-term paybacks. Managers expect it will take decades for residents to realand homes over two years. The kits will include a 60-watt roofmounted solar module with a battery for nighttime use at a cost of US\$1,200.

The project has about US\$6 million in private funding, including the nonprofit Hathaway Foundation and the Church of Uganda. It will run through 2020.



Manufacturing Move

Leading Chinese solar equipment manufacturer Shenzhen Topway Solar is seeking to transfer its manufacturing base to Uganda, a move that is likely to cut the cost of solar power. The 10-year old company, which will operate as the local vanguard company Suntopway Solar, currently supplies solar equipment to 15 African countries.

Shenzhen Chief Executive Officer Henry Hsia said the current solar electric systems in the country are not meant for the ordinary citizen, "but we are looking for a system for the ordinary man. We want him to buy a cheap lantern, take it home, instead of suffering with paraffin."

Suntopway is banking on the rural electrification policy which has been adopted by a number of governments in sub-Saharan Africa. Officials report that the investment will focus on the domestic population, specifically in rural areas, where only one percent of the population has access to electricity. They expect the cost of the solar modules to decrease by as much as 40 to 50 percent.

"We will be their sole distributors here," explained Solar Energy Uganda Limited managing director Richard Kainyike. "We will make sure that the lowest man in the village, with meager income, can really access these products." *—Adapted from Solarbuzz.*

Business Enterprises

This fall, Japan's Kyocera Corporation announced a joint venture with the nation of China to process and assemble solar panels. The venture recognizes China's labor market and the country's growth potential for solar panels. Kyocera will set up the project in Tianjin, China, with an unnamed local company.

to give the Chinese the benefit of our experience," said Alan Lloyd, chair of the state's Air Resources Board, which is using U.S. federal funds to help China set up an emissions-monitoring system. Windblown pollutants such as ozone, pesticides, and dust blow from China to California and the Pacific Northwest, and China's greenhouse gases are expected to rival those of the U.S. by 2020, significantly worsening the global climate problem.

The changes planned for implementation are wide-ranging, from setting energy-efficiency standards for appliances to ecological planning aimed at preventing pollution from spreading beyond the shores of the world's most populous nation.

Already, China has sharply increased its spending on green technologies and has reduced its carbon dioxide emissions by removing coal subsidies, shutting down old power plants, and switching to cleaner vehicle fuels. Efficiency savings are projected to cut China's annual residential electricity use by nine percent in 2010, a reduction equivalent to nearly half of all of California's household electricity consumption.

Advocates herald the program and predict great success. As the *San Francisco Chronicle*'s Robert Collier puts it, we're "at a time when the neither the U.S. government nor China's Communist rulers can figure out if the other side is friend or foe; the environmental connection with California is an encouraging bridge. It's good business for California and good news for the planet."

Solar for Developing Countries

At the recent World Summit on Sustainable Energy in Johannesburg, South Africa (see related article on page 15), the U.S. Department of Energy (DOE) announced efforts to deploy solar technologies to developing countries. These efforts will involve providing developing countries with resource assessment and mapping techniques to identify solar and other renewable energy capacities.

To foster this initiative, DOE will draw on its experience with renewable village power projects in Chile, Russia, China, Mexico, Brazil, and other regions.

Off-Grid Photovoltaic Power Systems

By Rolland Skinner and Les Tlustos

Opportunity is associated with remote or unique situations. The national cry is getting louder for green power. Proactive stances versus reactive stances have historically been the best avenue: "Get your mitt and get in the game." With thoughts like this in mind, consider—just for a moment—how solar power systems could be utilized to address key issues. Recognize solar has an ally when efforts are being made to improve the living standards in America.

Off-grid photovoltaic power systems are quiet, need no fuel, require very little maintenance, and operate best during the sunniest, hot days of summer. These systems are becoming the most popular alternative because of their low maintenance requirements and high reliability. Other advantages of off-grid PV include "free" energy, reliable power, flexibility, quick installation, and portability.

Consumer needs are varied and unique, as are the application of solar electric systems. PV systems are site-specific, will not replace the grid, are a sound addition to line extension and line replacement programs, are costeffective when used properly, and have proven to be a valuable asset when electric utilities provide guidance.

Using solar is sound business and all utilities need to understand the need to be proactive to address community concerns and utility acceptance. The biggest pitfall will be to ignore solar's potential. Utilities provide a point of contact, a knowledge base, and service. Reliable service, inventory infrastructure, and financing are also available through many utilities.

It is utilities that should be best suited for the point-of-contact knowledge base. This includes equipment specifications, safety, capacity parameters, efficiency levels, and project-specific knowledge. Project-specific knowledge includes properly designed and integrated systems. System installation, service, leasing, and sales should dovetail with normal operations.

Off-grid PV can be a positive and valuable addition to a utility's portfolio of options for service to its customers. Off-grid photovoltaic power systems are cost-effective at site-specific locations today, with many additional opportunities created by energy price spikes. Utilities are a critical partner in renewable energy applications. As partners, we can continue to improve the quality of life in America.

Awareness of what is being done or could be done is critical to fathoming the wide range of possibilities available to off-grid photovoltaic power systems, possibilities such as: riparian area restoration projects, livestock/wildlife watering, remote home/cabin power sources, remote signage capabilities, and remote lighting systems. Off-grid PV should be considered another tool in the toolbox.

Rural Utility Service endorsement of off-grid photovoltaic power systems would allow a uniform set of specifications, list of materials, and safety requirements relevant to America's standards. Off-grid photovoltaic power systems are a business opportunity, a quality of service opportunity, a customer-friendly opportunity, a cost-reduction opportunity and, last but not least, a value-added opportunity. It is the mission of electric utilities to provide customers with electricity, and the off-grid PV alternative is consistent with that mission.

When standard electric utility service is not a viable choice, it's time to explore the alternatives. In some cases, other power sources besides photovoltaic may be practical. But utilities shouldn't wait until their customers request solar energy before getting involved with PV. The ability of utilities to address these concerns will be of tremendous value to the American way of life. America is the remarkable promise of possibilities without limitations.

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ize a return on their investment. However, these investors appear to be involved for the long haul. Officials predict that those who make their rooftops available for a solar installation now will likely keep the roofs available for generations.

Nonprofits in Uganda Promote PV

Nonprofit organizations are promoting solar power in Africa. In Uganda, a development collaboration involving the Catholic and Anglican Churches for East Africa and the United States is providing solar power to support electric light and radio communications to areas of rural Uganda where electric grid extension is unlikely.

The goal is to replace kerosene lanterns with solar-powered kits at 5,000 churches, schools, health clinics, community centers,

China and California Team Up to Clean Up

California is one of the most environmentally minded states in the U.S.; China is one of the most polluted countries in the world.

California scientists and entrepreneurs are working with the Chinese government to combat environmental degradation in its myriad forms. The effort is being led by the Energy Foundation of San Francisco, which has spent \$5 million per year for the past three years on environmental causes in China.

California isn't acting out of pure altruism. "It's in our interest

CCX

The Chicago Climate Exchange (or CCX, <u>www.chicago</u> <u>climateX.com</u>) is the first voluntary pilot program allowing the exchange of greenhouse gases (GHGs) in the U.S. GHG emissions trading allows companies which produce emissions below an established level to trade emission "credits" with companies whose emissions exceed that level. As a result, a standardized level of emissions is emitted and there is a financial inventive to produce fewer emissions.

Since solar power is emissions-free, this power technology is ideal for governments or businesses involved in GHG credit exchanges. Generating more power using solar energy gives participants greater emissions credit trading leverage.



Photovoltaic systems, such as the one shown here, can be used in a range of off-grid applications, including water pumping, irrigation, and lighting. "Off-grid photovoltaic power systems," write the authors, "are a business opportunity, a quality of service opportunity, a customer-friendly opportunity, a cost-reduction opportunity and, last but not least, a value-added opportunity."

Net Energy Metered Solar Power in Hawaii Provides a Challenge

By Marco A. Mangelsdorf, Ph.D.

Since adoption of a net energy metered (NEM) law in Hawaii to promote the installation of small (10-kW and less) solar energy grid-connected systems, advocates have been surprised by the extremely underwhelming implementation of NEM systems. Given the typical abundant sunshine "very supportive" of solar energy, with 70 percent of business respondents and 98 percent of homeowners saying that they have installed or are considering installing solar energy systems. Translating this strong stated support for solar energy systems into greater numbers of NEM PV system purchases remains stalled on a business at the same location for the same cost, the system would pay for itself in less than four years.

Ironically, however, of the 18 systems that had been approved by September 2002, only three were purchased by businesses, 14 by homeowners, and one system for a home-based business. Specifically, critics cite



This map depicts the states that currently have net metering policies for grid-connected photovoltaic systems. Source: The Union of Concerned Scientists, 2002.

coupled with consistently high electric utility rates, NEM should be taking off, yet consumer adoption has been slow. A review of the NEM system by ProVision Technologies, Inc., shows that Hawaii residents do not have a lack of interest. Rather, high capital costs for residential systems and long payback periods coupled with seemingly inadequate incentives, makes installing a solar system impractical.

NEM allows customers with renewable energy (RE) systems to interconnect to their electric utilities and feed surplus kilowatt-hours into the grid, receiving credit at the full retail rate. NEM allows the electric meter to spin forward when electricity flows from the utility to the home or business, and backward when the RE system produces surplus power beyond what is being consumed at any given moment, thereby increasing the economic value of RE systems for customers. At present, 36 states have a net metering program on the books, with California leading the way with the highest number of NEM PV systems installed to date. As of September 2002 in Hawaii, only 18 NEM PV systems had been approved, inspected, and interconnected, an average of less than two installed per month since the NEM law was signed in June 2001. Regardless of their slow beginning, Hawaii residents advocate solar. According to a recent solar market survey carried out by the Renewable Energy Development Institute of California, Big Island businesses and homeowners are

challenging, however, as a substantial gap remains between this strong support in principle and making a commitment to spend tens of thousands of dollars on a grid-connected system. ProVision believes the gap exists because, under current regulations, residents see an investment in solar as financially impractical. NEM legislation makes solar installations practical for many businesses, but creates long-term payback periods for residential systems.

For example, last year in Waikoloa Village on the Big Island, a three-kilowatt dc NEM PV system was put up on a home for \$22,923. At the present effective kilowatt-hour rate and assuming the past 10year average annual energy escalation rate continues into the future, the payback period for this system is at 22.7 years. billing rules and a "lack of urgency" in both residents and businesses to explain the lack of use for solar systems. Currently, the best bill a customer can hope for is a balance of zero plus the minimum monthly fee; even if a customer produces a positive net flow of electricity back to the grid, the balance will never show a credit. This slows down the payback period for many systems, but, even if the billing were to change, Hawaii residents appear to be satisfied enough with the status quo of relying on high-priced utility power. As consumers become better educated about the benefits of solar energy, and with efforts of ProVision and local utilities, the demand for solar will soon increase.

Dr. Marco A. Mangelsdorf is the Market Representative at ProVision Technologies, Inc., in

A World Perspective On the Need for Solar

In September 2002, world leaders representing 200 nations passed an action plan calling for the expanded use of solar power and other renewable energy technologies. Meeting in Johannesburg, South Africa, at the *World Summit on Sustainable Development (WSSD)*, these leaders emphasized the need to bring renewable energy resources to areas that are currently without electricity, much less coordinated grid capacity, a role for which photovoltaics are uniquely suited.

Nitin Desai, Summit Secretary General, emphasized that the group was committed to expanding the use of green energy with "a sense of urgency." The nations, however, did not agree on setting targets for phasing in renewable energy systems as a whole.

Participating factions did agree to take additional measures to support renewable energy. For instance, the European Union (EU) unveiled its plan calling for a "coalition of the willing," countries able to go beyond the "vague" commitments that had been outlined previously.

"We are going to launch a coalition of the willing today to show that we will follow up on the energy initiative," said EU Environment Commissioner Margot Wallstroem. "We will form a coalition of those countries that are willing to use targets and dates."

Support for the proposal came from all 15 EU states, as well as Norway, Iceland, Switzerland, Poland, Hungary, the Czech Republic, Romania and Slovakia, Brazil, Argentina, Uganda, Mexico and other Latin American states,

plus some Caribbean and Pacific islands.

"By building on successful government partnership programs, such as SEPA's Solar Communities project, business can be convinced that re-

newable energy projects are successful and worth the investment" said Hank Habicht, CEO of Global Environment & Technology Foundation, a SEPA consultant. Mr. Habicht served as a Civil Society Member of the U.S. delegation at the Summit, and worked to ensure that the U.S included renewable energy in its commitments to a WSSD Initiative. Also, the "e7," a consortium representing nine major electric companies from the G7 countries, signed agreements to undertake sustainable energy projects in developing countries. The e7 (www.e7.org), founded in 1992, is an association of leading electric and energy companies from G7 nations. It is comprised of AEP (U.S.), a SEPA member; Electricité de France (France); Enel (Italy); Hydro-Québec (Canada); Ontario Power (Canada); RWE (Germany); Scottish Power (United Kingdom); Kansai Electric Power (Japan); and Tokyo Electric Power Generation (Japan).

that comprise e7 are collectively committed to promoting sustainable energy development," said Linn Draper, CEO of AEP and chair of the e7. "This means extending the benefits of electricity-including access to telecommunications, improved healthcare, expanded economic development options, and enhanced educational opportunities-to the nearly two billion people who live without electricity today. One of the paramount challenges in bringing the benefits of electricity to those living in energy poverty is that most of these people live in rural areas that are not easily connected to the electric power grid. Renewable energy technologies, especially distributed resources such as solar and wind power systems, will be important tools in addressing the obstacles to bringing electricity to the underserved rural populations of the world."

According to Christian Stoffaes, with Electricité de France, bringing electricity to all would need a total investment of about \$200 billion, or about \$7 billion per year over a 30-year period.

The e7 electric utilities say that they are working on various projects to bring electricity to rural areas. Shigeyuki Kuninobu, Vice President of Tokyo Electric, explained that the e7 is presently participating in 30 programs in 22 countries to build capacity and share technology to promote community participation and environmental protection.

According to Gail Karlsson of the nongovernmental organization Energia, grid system alternatives need to be developed to meet

> demand. Renewable mixes—including solar power, wind energy, hydroelectricity, and gas from biomass could be developed to meet needs as required. Desai closed

the Johannesburg Earth Summit by stating, "The goal of a target for renewable energy was worthwhile, but the reality is that, with sustained action, we can build

worthwhile, but the reality is that, with sustained action, we can build up the renewable energy industries to the point where they have the critical mass to compete with fossil fuel-generated energy. We

If this same system were in- Hilo, Hawaii. Tel: 808.969.3281.



The Body Blocks Power Association (BEPR) is an organization of energy service providers and utilities, photosofiats equipm and component manufacturers and service companies, educational initiations generoment operates and other deletablishes, of endorshing to balle widespread acceptance of and remove the barriers for action electricity finlogit permovings and market constpanent activities.

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Extending power grids worldwide will take many years and significant expense.

"The electricity companies

have a commitment to make it happen, and now we need the follow through.

"I would say this is the strongest mandate on energy that the international system has received," he added.

Summit officials estimated that more than two billion people lack access to modern energy services. In southeast Asia and Saharan Africa, many people depend on waste resources and fuel wood. Burning fossil fuels, of course, has been linked with a rise in carbon dioxide emissions.

Modern renewable energy resources produce only a small fraction of the world's energy needs, but their potential is enormous. Both utilities and the renewable energy industry can benefit economically and have a critical role in bringing these technologies to market throughout the world.

Tips for Homeowners | In Arizona One of the Largest Interested in Solar PV Solar Installations Gets Larger



A Solar Works employee installs a roof-mounted photovoltaic system on the roof of a home in New Hampshire.

How can homeowners maximize the benefits and minimize the difficulties of adding a PV system to their residences?

With careful planning, working with the local utility, using experienced installers, and taking advantage of state and federal incentives, many of the barriers to purchasing and installing a residential PV system can be eliminated.

Many factors drive homeowners to look to solar power for their electricity needs:

■ Solar electricity is an environmentally responsible alternative to fossil fuel generated electricity.

■ Photovoltaic systems (with battery back-up) provide energy security during blackouts.

■ Due to current economic conditions, investing in tangible assets, such as home improvement, is a good option.

■ PV provides stable electric bills in the face of the changing utility industry and the possibility of selling power back to the utility.

While most people support the idea of solar electricity, the majority know little about the technology or even where to purchase a PV system.

The first step for a homeowner is to investigate the available technologies using the Internet. BP Solar, for instance, lists national and international distributors of solar energy components which can also configure and install PV systems for residential and corporate end-users. PV manu-

utilities offer green pricing programs that allow consumers to purchase power generated by renewable energy sources.

There are many state and federal incentives for purchasing renewable energy systems. Some state governments provide low-interest loans, rebates, or detailed information packages to encourage homeowners to install solar energy systems. Interested homeowners should contact their state governments to find out the available incentives and the requirements to qualify.

The Database of State Incentives for Renewable Energy (DSIRE) is a comprehensive source of information on state, local, utility, and selected federal incentives that promote renewable energy (see www.dsireusa. <u>org</u>).

Once financing has been secured, interconnection requirements understood, and a PV system selected, the homeowner must select an installer. There is currently no national certification program for PV system installers; however, there are a number of state, local, and regional training or certification programs. Selecting an experienced installer is critical to maximize the PV system's performance and, most importantly, is necessary to ensure that the system poses no safety threats. The PV system vendor or the local utility can often provide information to homeowners to help identify qualified installers.

By Joe Salkowski

Tucson Electric Power Company recently expanded a solar generation site that is already among the largest of its kind in the world.

The site includes 22,276 solar panels spread out across 28 acres near the company's coal-fired Springerville Generation Station in northeastern Arizona. The site, which sits at 6,500 feet elevation in a cool, windy climate, produces enough "green" energy to meet the annual electric needs of 420 typical Tucson homes.

The solar array has a DC rating of 2,400 kilowatts at PV **USA Standard Test Conditions**

photovoltaic generation site operational in the Western Hemisphere.

TEP plans to expand this solar power station to help meet the state's growing demand for green power. By the end of 2003, the site should have a DC STC rating of 3.2 megawatts. The following year, with a planned DC STC rating of 4.0 MW, it will surpass the size of what is now the world's largest photovoltaic power plant, a 3.3-MW installation in Serre, Italy.

"We at TEP are committed to increasing our renewable generation assets for the benefit of our customers," said

Construction of the Springerville-area photovoltaic power plant is funded in part by TEP's GreenWattsTM program, which invites customers to sponsor "green" power projects. The ACC also has established small monthly surcharges on customers' electric bills to provide funding for renewable energy projects.

The Largest Site Has Unique Challenges

While TEP operates several smaller photovoltaic power sites with total installed capacity of 400 kW, Hansen said the Springerville-area installation is the company's most efficient



This aerial photo shows the 2.68-MW photovoltaic array, which takes up the 28 acres and is located in Springerville, Arizona. By the end of 2004, the array is expected to top four megawatts.

(STC). It has delivered more than 2,675 AC peak kilowatts of power, making it the most productive grid-connected

Tom Hansen, vice president and technical advisor for TEP.

Hansen said TEP will lean heavily on solar-generated power to satisfy an environ- that produces 157,000 watts, mental portfolio standard established by the Arizona Corporation Commission (ACC). 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. Global Solar Energy, Inc., a solar system designer and manufacturer of thin-film photovoltaic panels, served as project manager for the installation and oversees daily construction operations. Southwest Energy Solutions, a regional electric contractor, installed and connected all electrical components.

solar array.

"The difference is in the inverters," he asserted. "When you're building one inverter you can design for efficiency and reliability. When you're building 100 inverters rated at 1,500 apiece, you don't get that same level of efficiency." Of course, operating a large solar array involves its own unique challenges, including those posed by Mother Nature.

facturers and installers can provide information regarding the best technology for different roofing types, sizing, and battery back up.

The local utility must be contacted early in the planning stages to determine both the requirements for connecting the PV system to the electricity grid and the utility's policy for feeding excess electricity produced by the homeowner back to the utility. Additionally, many electric utilities have programs to assist customers seeking to purchase PV systems and may provide valuable, objective information on qualified installers, financing options, and the various PV technologies. For those homeowners interested in purchasing a PV system, but unable to afford one, many



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Global Solar Energy and SES are subsidiaries of UniSource Energy Corporation, TEP's parent company.

"We do have a problem trying to keep the weeds under control," Hansen said. "If you don't keep on top of them, they can grow high enough to start blocking the sun."

Hansen is considering hiring a herd of sheep from local 4H clubs to help control the vegetation.

Joe Salkowski is the Corporate Communications Specialist at Tucson Electric Power Company. Tel: 520.571.4000.

Rays That Pay! Solar PV Applications Reap Rewards

By Lisa Frantzis and Andy Greene

For years, consumers have been hearing the same story: solar photovoltaics (PV) are getting better and cheaper, but they're still many years away from competing with conventional electricity sources in gridconnected applications. We've also heard that those who choose to invest in end-use PV installations today must derive their satisfaction from a sense of environmental virtue, rather than project economics.

However, by tapping exist-

can make PV applications very attractive as an investment. For years, state and federal energy policy makers have been promoting policies intended to help stimulate PV and other renewable energy technologies. These policies vary from state to state and from utility to utility. In isolation, any one of these policies is probably insufficient to make grid-connected PV financially viable. However, in combination, they *can* get PV to market. The following show key value components for investing in PV:

■ Pay-As-You-Save (PAYS) financing mechanisms are moving from theory to reality in a few utility service territories, and could gain wider acceptance. Under PAYS, the local utility provides the upfront capital and installation assistance for distributed generation applications, such as PV, at the customer's premises. The customer repays the utility on a long-term basis (e.g., 20 years) such that the monthly cost savings are designed to exceed the monthly



This graphic illustrates the economic value of PV under a variety of circumstances.

ing and emerging market value benefits, PV installations can offer attractive financial results, in addition to the satisfaction of doing right by the environment. The key to making this market for PV is bringing together all the value streams and educating consumers about all of the possibilities and incentives that PV can offer today.

Conventional Wisdom: PV is Not Cost-Effective

From the perspective of most distribution and generation companies, PV applications still look pretty unattractive. Levelized costs of producing electricity from combined-cycle or simple-cycle combustion turbines are three to four cents per kilowatt-hour, versus costs of 40 cents per kWh for PV systems. While many distribution companies are required to give consideration to distributed generation technologies (such as PV) as a means of meeting both energy and distribution service obligations, very few have shown real interest in PV. Cost is invariably cited when utilities shun potential PV applications. In the past, end-use customers making investments in gridconnected PV systems have found that tax incentives and lower utility rates have been the key components providing project cash flow. Typically, such cash flows have been far below the levelized cost of PV energy, making PV unattractive as a financial proposition.

■ Electricity attribute trading systems (aka "green tags" and "certificates") like the New England Generation Information System, which started 15 July 2002, have arrived. Trading systems offer grid-connected solar producers a significant source of potential revenues. Grid-connected PV owners could see potential revenues of up to five cents per kWh just from the sale of the PV attributes apart from the electricity itself. Demand for PV certificates/tags stems from renewable portfolio requirements, and market demand for green electricity and tradable renewable credit (TRC)-based electricity products.

■ Net metering arrangements are available in the majority of states. Net metering allows the to \$5 per kW of PV costs have end-user to reduce or eliminate their consumption of power from the utility grid through on-site generation.

loan payment amount. The repayment obligation would carry over any new owners, negating the risk of "stranded investment."

■ An increasing number of states are adopting environmental regulations that award emission allowances (for NOx) for renewable energy projects, such as PV installations. The recipients of these allowances can resell the allowances in the open market and realize substantial market value.

■ The development of system benefit charge funds in many states that have restructured has led to several grant programs to buy-down the cost of PV installations at various end-user sites. Subsidies of up

PV Panels Top Store Roofs, Homes on L.I.

By Jim Ball

It's been a busy few months for Evergreen Solar, Inc., on New York's Long Island. In August and September, Evergreen Solar photovoltaic (PV) panels were installed on four of the six BJ's Wholesale stores there under the Long Island Power Authority's solar rebate program. The Marlboro, Massachusetts-based developer, marketer, and manufacturer of PV products also had a host of panels installed on residences under the program.

On the BJ's project, Evergreen worked with Conservation Services Group (CSG), another Massachusetts-based firm that handled installation of the systems. Ninety-six Evergreen Solar PV panels were installed on four BJ's stores-in Farmingdale, Islandia, Riverhead, and Westbury-producing 10 kilowatts of "green" electricity for each store and helping reduce the demand from LIPA during peak times. BJ's receives the power at a discounted rate and the PV systems are tied to the LIPA grid, although all the electricity generated will be used by BJ's. In addition, the installation will likely be available as a source for "green tags," renewable energy certificates or credits, which can be sold to a green energy provider in the future.

"We're very pleased to play an important role in the expansion of solar electric power on Long Island," said Mark Farber, Evergreen President and CEO. "Evergreen has been growing our business, building new relationships at home and abroad, [expanding] the reach of clean, renewable energy. We commend BJ's for its pioneering commitment to green energy and conservation programs. It is a terrific model for other firms."

After the installations were designed and permits obtained, construction began in the summer and was completed by the end of September. No roof penetrations were required to mount the PV modules to the roof. CSG has performed similar installations on stores in Rhode Island, Pennsylvania, and Massachusetts.

On the Residential Side

LIPA's rebate program, which paid \$6 per watt of installed power and ran through the end of July, proved very popular with customers. In fact, with Evergreen's active urging, the Authority granted an extension to 30 September 2002 for system completion so that participants could finish installations and take advantage of the generous rebate. LIPA has continued the rebate program at \$5 per watt for the first 500 kW of PV installed and \$4 per watt for the next one megawatt of installed PV

New York State also offers homeowners a 25 percent tax credit toward the total cost of a PV system, up to \$3,750.

"Incentives like these have helped make PV systems even more attractive for homeowners and businesses," added Farber. "It's another sign of the increasing viability of solar power and the important role it can play in meeting U.S. energy needs and helping us become more energy independent."

Jim Ball is the Vice President for Strategic Communications with Commonwealth Creative Associates. Tel: 508.620.6664.



PV That Pays! Incentives in combination

■ Some utilities offer time-ofuse (TOU) rates for distribution service and/or energy. TOU shifts the bulk of electricity cost to the peak period. This corresponds with the production profile of most PV installations, which produce during daylight hours (i.e., peak periods in TOU rate structures).

Several states offer one or more tax incentives for PV installations, including sales and property tax exemptions, investment tax credits, and production tax credits. Federal investment tax credits are currently in place for commercial entities; residential tax credits are currently included in the pending national energy bill.

been adopted in some states.

The graphic above depicts the cumulative effect of several of these incentives in tipping financials results toward net benefits for PV relative to levelized installation costs.

Finding the right combination of incentives for an individual project remains the main challenge to making a PV project financially viable. However, with many incentives now available, the amount of aid one project can obtain is growing in magnitude. In combination, incentives from tax credits, rate breaks, and grants are paving the road to widespread PV profitability.

Lisa Frantzis and Andy Greene are with Navigant Consulting, Inc., in Burlington, Mass. Tel: 781.270.0101.

Conservation Services Group installed this 10-kW Evergreen Solar photovoltaic system on the roof of BJs Wholesale in Long Island, N.Y. Three other BJs Wholesale stores in the Long Island area have similar photovoltaic systems installed on their roofs.

SEPA Congratulates SELF!

The Solar Electric Power Association wishes to extend its heartiest congratulations to the Solar Electric Light Fund for being a finalist in the 2002 Tech MuseumAwards.

Each year, the Tech Museum of Innovation in Silicon Valley honors inventors and visionaries from around the world who are applying technology to improve the human condition in the categories of education, equality, environment, health, and economic development.

SELF has been selected from among 460 nominees as one of five "laureates" in the Equality category. One Laureate from each category will receive a \$50,000 prize; the winner will be announced 7 November.

The Solar Electric Light Fund is a nonprofit organization that installs PV systems in offgrid rural villages in developing countries. Contact SELF, 1775 K Street, N.W., Suite 595, Washington, DC 20006. Tel: 202.234. 7265. eMail: solarlight@self.org. Web: www.SELF.org.

Commentary An Update on the Sacramento Municipal Utility District

By Jeffrey A. Serfass

Not withstanding the recent Sacramento Bee coverage of Sacramento, Calif., Municipal Utility District's audit of its PV program, SMUD continues to demonstrate its leadership in building the business case for solar electric power.

The audit report discussed several factors leading to the widely publicized difficulties in SMUD's PV program, including the valuation of a PV "generation credit," California Energy Commission (CEC) funding and module price budget impacts, and the assessment of all utility program costs. Among the several positive results of this intense internal study is that SMUD management is more knowledgeable than ever about the PV program and is adjusting its management structure to mainstream the solar program by integrating it into its customer service and other utility departments.

The SMUD Board has reaffirmed both customer interest and continued Board support for SMUD's PV business. Consistent with its long-term commitment to solar is SMUD's start-up this year of the CEC's \$13.8 million Renewable Energy Generation (ReGen) program, which seeks more residential solar roofing products and solutions to other PV market barriers.

As in any utility solar program, the economic benefits of the program rely on an assortment of energy, generation, customer service, investment deferment, and other values to the utility. One issue in the program audit is the value of the "generation credit," the reduction in generation costs provided by the PV system. SMUD has concluded, at this point, that it should not be taking the same credit for customer-owned systems as it does for utility-owned systems. Since the generation credit provides part of the program's value rationale and, therefore, part of the budget, the impact has been significant. This is an example of the important but difficult task of mainstreaming a "disruptive" technology like PV in a utility setting. SEPA looks forward to continuing discussions and analysis of this issue by SMUD and other energy service

Energy Photovoltaics (EPV) to begin manufacturing low-cost, thin-film PV modules at the local CalSolar facility. SMUD had estimated that EPV's module prices would significantly decrease and that SMUD would have a continuous supply of lower cost, reliable, PV modules. Due to manufacturing limitations at CalSolar, this was not the case. SMUD subsequently turned to the open, then very tight, market to purchase its PV modules. As a result, SMUD has been paying greater than a dollar per watt more for modules than budgeted.

The internal analyses included a thorough assessment of the costs of SMUD's installed PV systems. Recent analysis concludes that total installed costs, including the increased module costs, are higher than earlier realized, in the \$7 to \$9/W range, not the widely publicized under \$6/W.

With all of these factors com-

ing to a head in early 2002, many participants in the PV business were concerned about the future of SMUD's PV program. Not too worry. SMUD's Board support for the PV program is very strong as a result of very strong customer demand. While, for the remainder of 2002, the PV Pioneer II Program will not be accepting new customers, all commitments for 2002 will continue to be honored. SMUD is considering options for PV Pio-

neer I (SMUD-owned) participants whose contracts are almost over, and will resume taking new orders for the PV Pioneer II program in 2003.

With nearly \$14 million in funding from the CEC's PIER program, SMUD's ReGen Program has awarded contracts for 19 renewable energy research and development projects. While most of these projects address either solar electricity or solar thermal, funded



This is an example of one of SMUD's PV Pioneer homes, located in Sacramento, Calif.

projects include analytical and development efforts in biomass, wind energy, and landfill gas technologies.

ReGen has funded five projects investigating new PV roofing systems for residential applications. Among the funded projects is an effort with the Solar Electric Power Association to assess SMUD, TEAM-UP, and other business models and make recommendations to SMUD and the CEC for future business strategies to continue the expansion of this important Sacramento and California generation resource.

SMUD management is solidly behind the continued expansion of its solar program, which is now an integrated customer service option with tight management cost and performance oversight.

Jeffrey A. Serfass is founder and General Manager of the Solar Electric Power Association. Tel: 202.857.0898.

SEPA Chair Editorial **Aligning Common Interests for Success of PV**

By Mary O'Toole

I don't think there are any of us who are advocates of solar electric power who don't feel particularly challenged today to deliver the market results we seek. This is a tough environment. The economy is less than robust, our national leaders are focused on war and sometimes the solutions to the market challenges of this elegant technology seem to be constantly at the horizon... visible but still out of reach. Looking out over this horizon, we need to see clearly the challenges that face us, and pull together to address them.

Cost

While photovoltaic (PV) systems are cost-effective in many markets, we would have to list cost as the most obvious barrier to large market expansion. The solution to high cost is improved technology, reduced installation and balanceof-system costs and market expan-

sion. Since SEPA is an organization dedicated to building PV markets, this is where we continue to put our energy. Part of the solution to high cost is increasing market penetration through SEPA identification and communication of successful business models based on corporate and public values.

Value Proposition

Increasing penetration in markets traditionally served by gridtied electricity requires recognition of the value of PV, today and for the future. In today's world of changing FERC and state regulations that define the business models of utilities, SEPA must help everyone see all of the value streams, share success stories, and develop new thinking about PV's role in a distributed generation, open access world. To do this, we also need to keep an eye on the regulatory actions and make

sure, at the state and federal levels, that we articulate policies that provide fair treatment of PV and expanded interconnection ease.

State Funds and Budgets

In our Solution Power Solutions work for the Department of Energy, we recognized the growing role of state funding in driving PV market expansion. We are concerned today that use of these state funds must be effective and optimized for market expansion. If not, we fear these funds could be the subject of state budget cuts in an environment of shrinking state revenues. An evaluation of the effectiveness of the state funds should be undertaken. With SEPA dedicated to development of community-based PV programs, we should all strive to expand the number of states that allocate funding to communities for this purpose. Communications between state funds and the states' energy service providers is critical to achieve the desired effectiveness. And, during this period when PV has not reached a market sustaining price for grid-tied service, all sectors of local, state, and federal governments need to seek their own opportunities where PV provides a better solution to government energy needs.

We need to work collectively to address these challenges. While solar electric power is not THE solution for all markets, it is A solution in many markets, to meeting our energy needs more efficiently, more cleanly, with greater national security, and with greater returns to investors. SEPA, with others, seeks a greater understanding of the value proposition of PV and how we can, together, communicate and implement this proposition.

Mary O'Toole is Director of Environmental Strategy at Commonwealth Edison, Exelon.

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Solar Electric Power Association

providers.

SMUD's budget had included the receipt of funding from the CEC's Emerging Renewables Buydown Program. However, until a couple of weeks ago, the CEC buydown program guidebook stated that this funding is available only to projects that received no buydowns from other sources. Because SMUD provided its customers with PV systems at a subsidized price, these systems were deemed ineligible for the CEC funds, resulting in a negative budget impact on SMUD's PV program budget. Through the persistence efforts of the SMUD staff, the CEC revised its program guide to allow buydowns for 50 percent of a system's cost, up to a cap of \$4.50 per watt (ac). SMUD will be applying for buydowns that fit within the cap.

In 1997 SMUD partnered with



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