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Palo Alto program teaches value of facility maintenance

When granny warned that a stitch in time saves nine, she probably wasn't referring to operating, maintaining and recommissioning building systems, but the City of Palo Alto Utilities' pilot program for commercial and industrial customers may prove that her advice applies to more than socks.

The municipal utility launched its Operations, Maintenance and Recommissioning Demonstration Program in October 2003 at a meeting attended by 45 commercial and industrial customers. The OM&R program grew out of CPAU's APPA-award-winning plan that incorporates sustainable practices into all aspects of municipal operations.

From carrying out the sustainability plan, CPAU concluded that it is more cost effective—both in terms of money and energy—to take care of a system than to replace it. “In theory, it sounds so simple, it seems almost unnecessary to state it,” said Utility Marketing Services Manager Tom Auzenne. “But that is almost exactly the opposite of what happens in practice.”

Meter data improves budget decisions

Marketing services' research revealed that during difficult financial times, businesses routinely

reduce their OM&R budgets. That cost-cutting measure, however, ultimately leads to greater expense to replace equipment or systems that have either failed or are running so inefficiently that increased resource consumption adds tremendously to operating costs. The program defines recommissioning as adjusting systems or processes to return them to their original operating specifications.

The reasoning behind this strategy, Auzenne explained, is that it is hard to quantify the increased costs, particularly for energy and water, caused by delaying or terminating maintenance schedules. “The goal of the OM&R Demonstration Program is to provide C&I customers with solid data on system modifications and retrofits that will help them make investment-grade decisions in their capital budgets,” he said.

The Advanced Metering Demonstration Program, an offshoot of the municipal plan CPAU incorporated into the OM&R program, will collect the data. Participating customers agreed to install automated meter reading technology at their own expense. A consultant is currently verifying meter multipliers, fixing phone lines and debugging anomalies.

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Facility maintenance

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lies between AMDP data and maintenance shop and CIS data on a test group of customers via phone lines to their electric meters.

When the AMD program begins operating, participants will have access to online customer-specific Web pages, historical data for comparison, aggregates of data across any time frame, data in 15-minute intervals and consultation with utility personnel and project consultants when warranted. "In the city's experience, better electric data is an invaluable tool for gauging the success of OM&R efforts and developing capital improvement projects," Auzenne observed.

Energy leak detectives

Other components of the OM&R program include workshops on building lifecycle cost requirements into requests for proposals and a unique "Energy Visualization Project." The latter seeks to "put a face"

on energy efficiency efforts for people who are not ordinarily involved in maintenance.

Using infrared scanning technology, CPAU trainers locate energy leaks and then translate them into telltale signs that nontechnical employees can identify. "Heat leaks leave signatures, like a switchgear cabinet that is warm to the touch or a slight but increasing vibration in a motor that is generating heat," said Auzenne. "With training, every employee from the janitor to the CEO can learn to recognize the clues and help the company save energy."

Western's Equipment Loan Program and expert training and advice from the regional Energy Services representatives have been extremely helpful in developing the Energy Visualization Project, Auzenne added. "Most utilities either have their own infrared scanners or can easily borrow one from Western, so there is no good reason not to make the technology available to larger C&I customers," he said. "Finding a hot switchgear in a customer's facility pays enormous dividends. Infrared scanning is a great relationship-building tool."



As part of its Operations, Maintenance and Recommissioning Program, Palo Alto Utilities performed infrared audits on city facilities. One audit uncovered this malfunctioning condenser motor that caused a cooling tower to overflow because the pump was not operating correctly. (photo courtesy of City of Palo Alto Utilities)

The fractal light images infrared cameras produce are also a good tool for illustrating energy consumption to the general public and to companies that are not in the OM&R program. CPAU is working with the Public Art Commission to create an exhibit of building photos from infrared inspections to display at its headquarters, and at Palo Alto schools and community groups. "Hopefully, those color images of heat radiation will make people—especially big energy users—wonder what infrared scans of their facilities would look like," said Auzenne.

And that might lead them to think about ways CPAU's OM&R program could save their businesses money. Or as granny might say, one picture of an energy-efficient building envelope is worth a thousand words. ⚡

Energy Services Bulletin

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Project explores porker power

Southeastern Colorado Power Association set out to support a customer's anaerobic digester project and wound up as a partner in a cutting-edge renewable energy experiment that could create up to 4 MW of biogas-based electricity generating capacity and revive the state's hog-farming industry.

"It's our job to help our consumers," explained SECPA Chief Operating Officer Jack Wolfe. "In rural communities, that often means helping farms find ways to stay afloat and comply with environmental regulations."

Odor control amendment opens door

One such farm, the 5,000-hog operation Colorado Pork, LLC, in Lamar, Colo., meets that dual challenge by converting its animal waste to energy. In 1999, the farm received funding from the U.S. Department of Agriculture's AgStar program to build an anaerobic digester system from the ground up. With a matching grant from the Governor's Office of Energy Management and Conservation, the owner built a 500,000-gallon capacity, in-ground storage pit covered by a flexible reinforced plastic collection dome.

The biogas captured from about 12,500 gallons of daily manure initially fed a modified natural gas engine, generating about 40 kW. Combining the system with energy efficiency measures, Colorado Pork reduced its monthly electric bill to about \$3,500, compared to the \$10,000 to \$11,000 costs typically associated with farms of that size.

Equally important, the airtight

digester cut down the manure volume and reduced odor levels to fully comply with Colorado Amendment 14, which regulates odor emissions. Among its requirements, the 1998 legislation mandated large commercial hog farms to place impermeable covers on all anaerobic lagoons.

Project has unique twist

SECPA's first involvement with the project was helping the farm interconnect the anaerobic digester to the grid. That changed in December 2001 when Colorado Pork and OEMC added a Capstone 30-kW microturbine to the system.

SECPA and Tri-State Generation and Transmission joined the demonstration project to test the feasibility of the microturbine/anaerobic digester combination. Capstone Turbines, the Department of Energy, Colorado Department of Public Health and Environment, McNeil Technologies and Southeast Land and Environment were among several other partners in the project. In the year-long study, the microturbine and internal combustion engine ran side by side to compare performances, including emissions and other variables. Together, the two machines provided about 35 percent of the farm's electricity and 50 percent of its peak load.

The project was also the first to be net metered under Colorado's 2002 net metering bill. Colorado Pork plans to sell any excess power it produces to SECPA, although so far none has been sent to the grid. When that day comes, the utility, its power wholesaler, Tri-State, and



A group from the Governor's Office of Energy Management and Conservation tours Colorado Pork's anaerobic digester. (photo courtesy of Southeastern Colorado Power Association)

the farm will pay Colorado Pork the avoided cost for surplus power and allow SECPA to buy the power off the grid.

Technology cost and maintenance

In mid-2004, Colorado Pork and OEMC will install a 55-kW Stirling combustion engine to operate along side the CAT and the Capstone. Tri-State is funding a study by the Electric Power Research Institute to compare all three generators at once, another first. The goal, said McCoy, is to determine which technology makes the most cost-efficient use of methane and to ferret out design weaknesses that could add to maintenance.

The farm is experimenting with adding chemicals to the manure and grinding the waste to boost methane extraction. Not that biogas is likely to become a second cash crop for hog farms, McCoy pointed out. On the other hand, "People have to maintain and operate biomass generators, and that creates jobs in rural areas. And anaerobic digesters help livestock operations to be better neighbors while containing operating costs," he added. ⚡

Want to know more?

Visit www.wapa.gov/es/pubs/esb/2004/feb/feb042.htm

Lenox wind turbine attracts interest

Lenox, Iowa, Municipal Utilities knew that its wind turbine, launched at the end of November 2003, would supply 10 percent of the city's energy needs, but the big surprise was how much interest the 750-kW unit generated in the new Green City Energy program the utility rolled out around the same time.

Compared to the national average of 1 to 3 percent participation in green power programs, nearly 13 percent of LMU's 550 households signed up to contribute a portion of their monthly bill to renewable development. Although General Manager Dave Ferris has no statistics to prove it, "I'm sure the wind turbine helped," he speculated. "People come in off the street to ask, 'How much are we putting out today?'"

Project plans ready

It was a happy coincidence that the turbine and the green power program went online about the same time, since the projects developed independently. The city discussed the possibility of building a turbine for a few years and had even completed a feasibility study. "Up to that point, it was a break-even deal," recalled Ferris. "We had the wind resources, but until the DED block grant, we didn't have the economic resources to move forward with it."

The Iowa Department of Economic Development approached the Iowa Association of Municipal Utilities in 2002 to learn if any of IAMU's members might qualify for Federal pass-through money awarded as community development block grants. To be eligible, 51 percent or more of a municipal utility's cus-

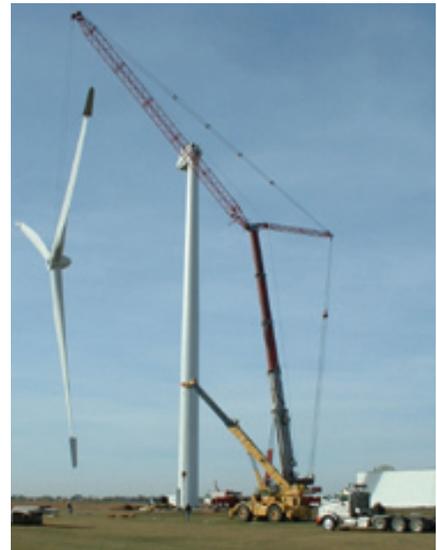
tomers had to be low or moderate income. "We knew that Lenox not only met the qualifications, but that it had a renewable energy project on the drawing board," recalled IAMU Energy Services Coordinator Patti Cale-Finnegan.

Lenox received a \$400,000 community block grant, which paid for about half the cost of building and interconnecting the unit. A loan from the city's electric reserve fund covered the remaining cost. Iowa Governor Tom Vilsack broke ground for the wind turbine on April 22—Earth Day 2003.

A few months after Lenox began building the wind turbine, the Iowa Utilities Board completed the final rules for carrying out a state law requiring all utilities to offer their customers some sort of green power program. The law covered municipal utilities and electric cooperatives as well as investor-owned utilities, but gave consumer-owned power suppliers some flexibility in meeting the requirements. "The intent of the law was to support renewable development in Iowa," said Cale-Finnegan. "IUB knew that a lot of small towns and RECs would need time and assistance to develop their own renewable products."

To help its members, IAMU created the Green City Energy umbrella program. Green City Energy borrowed basic elements from larger utilities' green power programs that small utilities could customize to meet local needs.

LMU customers may pay an additional \$2 each month, for 100-



Lenox Municipal Utilities was ready to move forward with construction when it received Federal pass-through money to develop a renewable energy project. (photo courtesy of Lenox Municipal Utilities)

kWh blocks of renewable energy. The utility requires a yearlong commitment and applies the contribution to paying off the wind turbine. "When everyone in town looks up at that 50-meter turbine spinning, they know what their money is paying for," observed Cale-Finnegan. "It's got to be a great marketing tool."

More opportunities

The addition of local wind power to LMU's generation portfolio and the success of the Green City Energy program have made Lenox, Iowa, one of the greenest cities in the country. "Supporting renewable energy and making Lenox a green city is a way we can ensure that what we're leaving to our children and grandchildren is a clean environment, a healthy economy, and a secure nation," explained Ferris. ⚡

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Visit www.wapa.gov/es/pubs/esb/2004/feb/feb043.htm**

Incentive program keeps S.D. county in hot water

Most utilities wouldn't consider an incentive program that resulted in the installation of 500 super-efficient electric water heaters over 13 years a runaway success unless the utility was Union County Electric—serving 1,000 customers.

The tiny municipal utility in southeastern South Dakota also offers rebates on compact fluorescent light bulbs, ground source heat pumps and other types of energy-efficient electric heating systems, but its Marathon water heater program is by far the most successful.

Each year for the last six years, about 30 customers have taken advantage of the utility's \$2.50-per-gallon rebate to replace their inefficient old water heaters, mostly with Marathon's 85-gallon model. East River Electric Power Cooperative, Union County's power wholesaler, offers another \$2-per-gallon incentive. "We deduct the rebates at the time of the sale, which helps," said Morse. "People can walk out of here with a Marathon for around \$187."

Quality product, intensive marketing

The incentive program began 13 years ago when East River told Morse about a new, nonmetallic hot water heater with a lifetime warranty. Water Heater Innovations, Inc., manufacturer of Marathons, invited the G&T and its member co-ops to tour its Egan, Minn., facilities. The utility managers liked what they saw there—a hot water heater with an R-20 insulation factor that used the same amount of electricity to heat

85 gallons that conventional units used to heat 55 gallons.

Water Heater Innovations was also willing to work with small utilities to make it easier for them to carry Marathons. For example, most manufacturers offered free delivery on a minimum order, usually of 50 units, on a factory-direct basis. That order was more water heaters than a co-op like Union County could store or sell in a year. "So they dropped the number to something we could manage," said Morse. "And they are quick to resolve any problems with the merchandise. I have no complaints at all about working with the company."

Union County joined East River and its member co-ops in offering Marathons for sale to their customers and providing rebates on installation. Morse promoted the program with ads in the utility's "Cooperative Connections" newsletter, ads in the county's local weekly newspaper and joint ads in East River's newsletter. The manufacturer supplied brochures and displays for the lobbies of utility offices.

Sub-metering data enhances advertising

In Morse's view, members would be more likely to install Marathons



A tour of Water Heater Innovations, Inc., the Egan, Minn.-based manufacturer of Marathon water heaters, persuaded several East River member co-ops to offer the super-efficient units to their customers. (photo courtesy of Water Heater Innovations, Inc.)

if they knew exactly how much the super-efficient water heater was going to help them.

The member services director sub-metered different sized units in several different settings and invited users to read the meters themselves. Members reported substantial savings over a four- to five-year period, giving the utility hard data to support the program.

The incentive program took several years to gather momentum, but eventually 50 percent of Union County's members installed Marathons—and the market isn't completely saturated yet. The utility was set to beat its 2003 projections on rebate requests, with 36 installations and a month left in the year.

In the last few years, the county got two major housing developments and 50 to 60 percent of those homes installed Marathons. About 33 percent of the new houses will be heated by geothermal heat pumps. ⚡

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Visit www.wapa.gov/es/pubs/esb/2004/feb/feb044.htm

Industry pioneer urges local wind development

Nebraska farmers are sitting on a resource that could turn into a valuable cash crop with the potential to revive the state's rural communities—if they plant locally, a wind development pioneer told the Nebraska Farmers Union at its state convention in Grand Island, Neb., last December.

NEFU invited Dan Juhl, owner of the wind energy development company DanMar & Associates, Inc, to present "Farming the Wind: The Minnesota Wind Power Experience" at its 90th annual meeting. "The union's position is that as a nation, we need to develop more secure, environmentally friendly energy sources that use agricultural commodities," said President John Hansen. "We've focused heavily on ethanol production, biomass and soy diesel, but it's time to turn more attention to the state's wind resources. Nebraska could be producing a lot more wind power."

Small projects strengthen economies

According to the American Wind Energy Association, Nebraska's wind resources rank sixth in the United States, with the potential to generate an average of 99,100 MW annually. So far, the state has tapped only 14 MW of that power, although Nebraska Public Power District recently announced plans to build a 30-MW wind farm near Ainsworth, Neb.

Large wind farms are only one option for harnessing the state's vast wind resources, said Hansen. "By spreading individually owned wind

energy throughout the region, we can develop wind power in a way that helps the family farm."

Juhl shares Hansen's conviction that local development maximizes the benefits to rural communities. "When locally-based landowners build small wind projects using local contractors, and either use the power themselves or sell it to their utility, it strengthens the local economy," he said.

What is good for a utility's customers is good for the utility. Such distributed generation projects make the power supply more secure and rarely require complicated interconnection arrangements. "Small units produce power close to the load that can be consumed by a community before it even enters the transmission system," explained Juhl. "That makes dispersed generators easier for small utilities to manage and it makes renewable energy more affordable."

Tax incentives make wind power more cost effective, too, but as Juhl pointed out, those programs are not open to public power providers. "Community-based development groups can take advantage of the credits, though," he observed.

Minnesota policy offers model

To create a favorable environment for local wind development, Hansen believes that groups like NEFU must educate their legislators, their utilities and their own members about renewable energy issues and benefits. "Everyone needs to know what the options are so we can recognize

the opportunities," he said.

NEFU energy policy supports the development of wind energy for rural economic development, and the organization is actively involved in discussions at the state and national level. Hansen said that his organization is also encouraging the state to adopt the Minnesota model for financial incentives for renewable energy development.

Key provisions in the Minnesota policy include a 10-year small producer (2 MW or less) production incentive of 1.5 cents/kWh for nontaxable entities or a 1.8-cent tax credit for businesses. Wind energy systems receive a break on property taxes, too. "The law recognizes that the system has a greater value to the community than a little more property tax," said Juhl.

State legislators and public utilities worked together to develop a standardized power contract for small projects. Measures like simplifying the negotiation process provided a huge boost to local development, Juhl noted.

Local providers play role

Municipal utilities and rural electric cooperatives can support local renewable energy, too, by making contracts available to their members. "A lot of small utilities have economic development funds to help establish small businesses in their territories. Why not consider a wind turbine the same as any other small business producing a saleable commodity?" Juhl suggested.

Under Minnesota's renewable energy policy, the state currently

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Kansas writes rules for interconnecting renewables projects

The Kansas State Legislature passed a bill in April 2003 that will make the state one of the few in the country to have its own statewide uniform interconnection standards for distributed renewable energy systems up to 5 MW.

The Kansas Corporation Commission, which regulates the state's public utilities, common carriers, motor carriers and oil and gas producers, is taking the lead on drafting the new rules. KCC Energy Manager Jim Ploger believes that standardization will ultimately make developing renewable energy projects easier. "Among other things, it will clarify the application process and set fees for grid-tying a system," he observed. "Vendors, especially locally, will be able to give their customers a better idea of how much time and money a project requires."

Wind development

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produces 425 MW of wind energy that pours nearly \$500 million annually into local economies. The Nebraska Farmers Union would like to see the same thing happen in its state. "Advances in wind technology have made small projects increasingly viable and it keeps getting more competitive all the time," Hansen stated. "It's not just good energy policy now; it's good domestic economic policy."

"Wind is a mature, efficient and reliable, but nondispatchable source of clean energy," Juhl added. "Small wind generators can and should play a big role in powering our rural communities." ⚡

State standards

KCC opened Docket no. 04-GIME-080-GIE July 23, 2003, to review and analyze proposed standards. Ideally, the state's standards will complement the Federal Energy Regulatory Commission's proposed interconnection procedures, with an added focus on distributed generation. FERC regulations only apply to generators that connect directly to the transmission systems of FERC-transmission owners. Many small applications connect directly to the lower voltage distribution power lines serving small commercial and residential retail customers. "To encourage the development of Kansas resources, standards have to address the unique needs of projects under 2 MW," explained KCC Energy Operations Chief Larry Holloway, the lead staff person assigned to the docket.

The commission is looking at model standards proposed by the National Rural Electric Cooperative Association and Interstate Renewable Energy Council. Some of those rules were incorporated in early versions. "It's been through several iterations already, and we'll be holding more roundtable discussions to get input from the parties that will be subject to the rules," said Holloway. "We're at least a year away from a completed procedure."

Co-ops help craft standards

The new standards will apply to all utilities under KCC's jurisdiction. Only two rural electric cooperatives are under commission jurisdiction, added Ploger, so REC and municipi-

pality compliance will be voluntary. "But they have shown a lot of interest in the process," he said.

Workshop covers interconnection issues

With their member-owners' interest in mind, Kansas co-ops and municipalities made a strong showing at an implementation workshop KCC organized in cooperation with IREC. A total of 50 people attended the event, including representatives from the commission's major jurisdictional utilities and policymakers from Kansas Energy Cooperative.

The agenda offered an overview of how establishing interconnection standards would affect Kansas energy providers. Among the topics the workshop covered were national codes and standard development and the legal aspects of interconnections. Utility representatives discussed their current standards and learned how other states handle the issue.

In adopting a state standard for interconnecting renewable generators to the grid, Kansas is breaking new ground. According to a National Regulatory Research Institute survey, New York, Texas and California are the only states so far to adopt their own standard procedure and standard agreement for distributed generation interconnection, with Oregon and New Jersey expected to follow shortly. Ploger is looking forward to seeing Kansas join that company. "Kansas utilities are ready to do something progressive, and state standards will open the door, not just to wind, but to fuel cells, biomass and solar projects," he noted. ⚡

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Visit www.wapa.gov/es/pubs/esb/2004/feb/feb046.htm

California building standards raise bar for efficiency measures

The California Energy Commission recently voted unanimously to update Title 24, Part 6, the state's Energy Efficiency Standards for Residential and Nonresidential Buildings, incorporating new measures and technology to reduce energy use, including peak use.

The latest round of revisions are projected to cut the state's peak energy use by more than 180 MW annually after they go into effect in 2005. Utilities, window manufacturers, the California Building Industry Association and the Natural Resources Defense Council were among those applauding the approved changes.

"For utilities like the Sacramento Municipal Utility District that produce part of their power and buy the rest, the changes mean we will have to buy less power in the future," commented Jim Parks, SMUD program manager for energy efficiency and customer research and development.

Revisions target peak use

To develop the new standards, the energy commission conducted a public process, soliciting ideas, proposals and comments from all interested people. Staff contacted representatives from affected industries and citizens who signed up with the commission to receive notification. A consulting firm and a number of nationally recognized lighting experts also helped with the project.

The most significant changes focused on reducing peak energy use. Air conditioning loads on hot

summer days can cause the state's need for power to nearly double. The new code requires residential buildings to install cool roofs — highly reflective, insulated roofing. In California, nine out of 10 rooftops reach summer peak temperatures of 150 degrees to 190 degrees. A cool roof can reduce those temperatures by as much as 50 degrees. That large temperature difference translates to a 20-percent reduction in air conditioning costs.

Ductwork, particularly in residential buildings, also received attention. Standards for new heating, ventilation and air conditioning equipment will require ductwork to be inspected and sealed to correct the inevitable large leaks in existing ducts. Also, several changes make space heating, cooling and ventilation systems more efficient in both residential and nonresidential buildings.

Standards address indoor, outdoor lighting

Major improvements in efficient lighting technology made their way into the standards, too. The revisions require "big box" nonresidential buildings to be equipped with skylights and sensor controls to turn



Updated building standards will require all new commercial buildings with low-slope roofs to be fitted with highly reflective "cool roofs." A study by the Florida Energy Center found that buildings with light colored, more reflective roofs use up to 40 percent less energy for cooling than darker roofs. (artwork courtesy of California Energy Commission)

off electric lighting when natural daylight is sufficient. Also, all permanent fixtures must use state-of-the-art fluorescent lighting. Parks noted that the commission incorporated a recommendation by SMUD and a lighting manufacturer that the requirement for electronic fluorescent lighting ballasts be lowered from 18 watts to 13 watts, thus saving energy and improving performance.

Outdoor lighting and indoor and outdoor signage—areas building standards rarely cover—feature prominently in the new standards. Requirements for control, efficacy and maximum power densities for indoor lighting have been on California's books for more than 20 years. Acting on the directive of Senate Bill

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Visit www.wapa.gov/es/pubs/esb/2004/feb/feb047.htm

Building standards

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5X, the energy commission extended those requirements to encompass outdoor lighting applications.

Training, resources educate building industry

The commission will work closely with building officials, builders and utilities to provide training on the new standards, educating everyone to the changes before they go into effect. CEC sponsors training centers at SMUD, Pacific Gas and Electric Company, Southern California Gas Company, San Diego Gas Company and Southern California Edison. The centers offer hands-on training for building officials and builders on construction techniques for complying with the standards. Each training center is equipped with displays of energy-efficient equipment and techniques, and labs and mock-up facilities for demonstrating diagnostic equipment.

Ongoing workshops and seminars reach a wide audience. "The building industry has to be apprised of changes in the standards," said Parks, "and utilities need to know how the standards are going to affect their energy efficiency programs. For example, rebate plans have to be adjusted to meet the changes."

Manuals play a big part in the education process as well. Legislation specifies that training materials must be updated no later than 180 days after the adoption of new standards. The CEC also produces design suggestions for meeting or exceeding the standards and a computer program for calculating

energy consumption in residential and nonresidential buildings.

Building officials, energy consultants, builders, contractors and homeowners can get answers about specific applications of the standards from CEC's Energy Hotline. The toll-free service puts callers in direct contact with code specialists on the commission staff. Hotline staff also answer queries by e-mail.

Professionals and consumers outside the state can benefit from the CEC's expertise through the on-line Consumer Energy Center. The Web site offers consumer tips, videos, case studies, useful links and a glossary of energy terms. Visitors can download commission reports and manuals free of charge. While most documents pertain specifically to California, builders and utilities everywhere must deal with the same issues of environmental protection and wise energy use, and may gain valuable insight from California's experience.

Commitment proves rewarding

The CEC adopted the first Energy Efficiency Standards for Residential and Nonresidential Buildings in 1978 to control electricity use that had been growing at an annual rate of 8 percent. The standards apply to new construction, including requirements for entire new buildings, additions and alterations and repairs to nonresidential buildings.

Periodic updates allow for the incorporation of new energy-efficient technologies and conservation methods. The 2000 energy crisis prompted an emergency update of the code with substantial changes aimed at reducing summer peak demand. Immediately after completing those revisions, the commission

began the public process to consider more extensive requirements that could not be developed within the 120-day timeframe of the emergency proceeding. These changes make up the 2005 Standards the commission adopted on Nov. 5, 2003.

Title 24 sets an example for progressive energy conservation policy and drives California utilities to develop new strategies to save energy. "When the standards tighten, last year's energy savings become this year's norm, and we have to identify new measures to increase the savings," explained Parks.

The CEC estimates that from its inception to 2003, the code, along with standards for energy efficient appliances, saved Californians \$56 billion in electricity and natural gas costs. In addition, it improved outdoor air quality by reducing emissions from powerplants and from natural gas combustion in furnaces, boilers and water heaters.

A recent study by the RAND Corporation found that energy efficiency has helped the state economy, too. California's Standards and other investments in energy efficiency have resulted in the state having very low energy intensity (energy consumption per economic output) compared to the rest of the United States. This led to a 3-percent increase in the state's economic growth, the equivalent of putting between \$875 to \$1,300 in the pocket of every Californian, creating jobs and increasing California's business competitiveness. ⚡

Researchers, companies aim for efficient PV cells

In spite of the benefits renewable energy has to offer, utilities often cite the cost of alternative technologies as a barrier to developing more distributed generation projects. Many renewable energy experts believe that the key to making renewable resources, such as solar power, more competitive with fossil fuels is to bring down the high cost of materials and production. Several companies are working on new techniques to make photovoltaic cells a more affordable—and versatile—option.

For conventional solar cells made of crystalline silicon, material cost is the most expensive part of the unit. Also, the silicon must be processed in elaborate clean-room facilities, like computer chips, adding to the production cost. The most promising solutions fall mainly into two categories: develop a manufacturing process that uses less crystalline silicon or make cells out of a different material.

Thin is in

The Australian company Origin Energy is one of the leaders in the “less-material” camp with its patented Sliver Cell technology, developed in cooperation with Australian National University. According to Origin, the solar cells are less than 70 microns thick and convert 19.5 percent of the solar energy that hits them into electricity. Conventional industrial cells are about 300 micrometers thick and have an efficiency value of about 16 percent.

“Sliver Cell technology needs

the equivalent of two silicon wafers to convert sunlight to 140 watts of power,” explained Professor Andrew Blakers, director of the ANU Centre for Sustainable Energy Systems. “By comparison, a conventional solar panel needs about 60 silicon wafers to achieve this performance.”

Researchers at the Fraunhofer Institute for Solar Energy Systems in Germany are slicing their crystalline silicon even finer—nearly half the thickness of the Origin cells. The Fraunhofer ISE scientists claim to have produced a crystalline silicon solar cell that is only 37 microns thick and achieves a solar energy conversion efficiency of 20.2 percent.

Tokyo-based PV specialists MSK achieve savings by making solar cells that are a little thinner—200 micrometers—rather than a lot thinner. The company’s recently opened module production factory in Nagano, Japan, is geared to handle the thinner cells and keep pace with other advances in PV cell technology. The facility also has the economy of scale working for it with the capability to produce 45,000 solar modules per month. It is the world’s largest module production capacity at a single site.

Research focuses on new materials

Flexible, “organic” PV material like malleable polymers offer a vastly less expensive and more versatile alternative to crystalline silicon, researchers say, although one that so far is considerably less efficient.



Sliver technology uses innovative manufacturing techniques to produce individual cells of less than 70 microns thick—thinner than a human hair. The cells use 90 percent less silicon than current conventional solar PV modules. (photo courtesy of Origin Energy)

Such PV “films” have existed since 1986, according to Princeton electrical engineering professor Stephen Forrest, but have efficiency rates of only 1 percent.

Forrest heads a team of university electrical engineers that invented a technique for producing a new class of ultra-thin, organic photovoltaics. As reported in the Sept. 11 issue of *Nature*, the researchers broke the one-percent efficiency barrier by changing the organic compounds used to make their solar cells, yielding devices with efficiencies of more than three percent.

The team’s most recent advance involved finding a new method for forming the organic film, “which increased the efficiency by 50 percent,” Forrest told the scientific journal. The innovation, he continued, could lead to cells being manufactured in a process some-

See PV CELLS page 15

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Western recognizes University of North Dakota's energy-savings program

The harsh winters of the upper Great Plains hold no fear for the University of North Dakota, Grand Forks, first in its division in hockey and first among educational facilities to receive Western's Administrator's Award for customers with superior achievements in energy efficiency or renewable energy.

Representatives from Western's Upper Great Plains regional office braved eight inches of snow Dec. 15 to honor UND and tour some of the campus projects that helped earn the award. UGP Regional Manager Robert Harris praised the university's staff for its top-down commitment to providing a safe, quality, energy-efficient learning environment. "It's a great example of what one customer can do to further the country's goals of energy independence and a cleaner environment," he said.

Cost-saving efforts

Western provides more than 60 percent of UND's electrical energy requirements. UND is a coeducational, state-supported institution with an enrollment of more than 12,000 students. The campus facilities department maintains 239 buildings covering more than six million square feet.

The Administrator's Award recognizes the success of UND's campus-wide energy efficiency program, the innovative program funding and the energy management team carrying out the program. UND designed the program to affect every facet of campus energy use, including electric, gas, oil, steam, water and sewer systems. "When we first started back

in the '70s, we were really the only kids on the block doing energy efficiency," said Facilities Director Larry Zitzow. "The program has evolved through decades of research and experiments into something the entire university is very proud of."

There were two reasons the university entered the largely uncharted territory of facilities energy management in those days, Zitzow recalled: "Money and manpower, which actually comes down to the same thing," he said. "Hooking a few buildings up to early building automation software allowed us to reduce the workforce, because we no longer needed a person in every building to tell us what was happening."

Partnership supplies new technologies

Honeywell supplied the first automated monitoring systems through a partnership with UND. "Initially, we didn't have a lot of funding for our energy management program, so the university applied to become a research and development site for Honeywell," explained Technology Advancement Coordinator Randal Bohlman. "We've helped them develop new products, and our buildings have been alpha and beta test sites for software programs."

Currently, 108 campus facilities are equipped with state-of-the-art automated systems that monitor, adjust and report on building



UND staff and Western Energy Services representatives display the Administrator's Award at the Dec. 15 award ceremony. (From left to right) UND Assistant Director of Facilities Mark Johnson, Technology Advancement Coordinator Randal Bohlman, Director of Facilities Larry Zitzow, UND President Dr. Charles Kupchella, Western UGP Regional Manager Bob Harris, North Dakota Field Representative Jim Bach, UGP Energy Services Manager John Pankratz and UND Communications Center Supervisor Pam Zimbelman. (photo courtesy of Chuck Kimmerle, UND Office of University Relations)

energy use. The results are award winning, to understate the case. In 1980, facilities department records show that at peak load, the steam plant pumped 247,000 pounds per hour to heat 3.1 million square feet. Today, the square footage of campus buildings connected to the steam plant has more than doubled, while the system's peak load has not gone over 220,000 pounds per hour in the last three years. "That's kind of a Cinderella story for a facilities department," said Bohlman, who has been instrumental in the energy program's success.

Western's Energy Services equipment loan program also contributes to the university's energy savings and electric system reliability. The facilities department borrows infrared cameras to perform regular scans of the campus electrical system, both above and below ground. Scanning,

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along with frequent quality tests on transformer fluid, identify potential problems, allowing for scheduled maintenance shutdowns. Scheduling is critical to a research institute like UND, said Zitzow. "Nobody likes to lose power in their lab or classroom, but they can plan around a scheduled outage," he said. "If a research lab experiences an unexpected power loss, it can destroy thousands of dollars worth of work."

Bond money finances projects

Borrowing diagnostic equipment and partnering with product designers helps to contain costs, but like any other effective program, energy efficiency needs a funding source. UND uses bond funds the 2002 North Dakota legislators established for institutions to plan and implement energy-saving projects. Institutions borrowed money from the fund for projects that would repay the loan through savings on utility bills. "Projects that demonstrated prompt payback got the funding," Zitzow said.

The state awarded the university \$3.9 million of that bond under its Facility Energy Improvement Program. Zitzow attributed the large award to UND's documented energy management success and having the technology and experienced staff needed to carry out the projects. The award financed 11 projects that have generated an additional \$640,000 in yearly energy savings, providing a simple payback of 6.2 years.

One recently completed project involved heating a building by capturing the kinetic energy from computer systems, lighting and even building occupants. The automation system determines where and when heat is needed and circulates it through the existing air ducts. The 60-horsepower motor that drove the building's fan has been replaced by a 40-horsepower motor that circulates one-third more air using only 50 percent of its capacity. "We reduced heat demand 60 to 80 percent by using the automation system to its fullest extent. I haven't seen a heat valve open all winter," said Bohlman, who designed the project.

Dedicated staff a plus

As technical advancement coordinator, Bohlman is the energy efficiency program's secret weapon. Trained in industrial engineering, he joined the facilities department in 1975 as an electronics technician. His job evolved over the years as he applied his understanding of building controls to energy-saving strategies. "Every campus wishes it had somebody like Randy," Zitzow observed. "The state doesn't really have a classification for what he does."

In simple terms, Bohlman makes sure the university gets the most from its energy management technology. Collecting data on all the factors that affect energy use, consulting with engineering experts and developing computer models are all part of Bohlman's work.



UGP Regional Manager Bob Harris presents the Administrator's Award to UND President Dr. Charles Kupchella. The University of North Dakota is the first educational institute Western has honored for its energy efficiency achievements. (photo courtesy of Chuck Kimmerle, UND Office of University Relations)

Western is not the first Federal agency to recognize UND for its innovative efforts to lower its energy consumption system-wide. In 1994, Secretary of Energy Hazel O'Leary honored the university for measures that reduced its steam plant's fuel use by 6.5 percent, with a payback of less than five years.

Having become the first educational institute to receive Western's Administrator's Award, UND has set its sights on becoming an Energy Star education partner. "We're just plowing the ground to see what it leads to," Zitzow said.

Considering the UND facilities department's knack for turning challenge into opportunity, it will probably lead to more energy savings. ⚡

Want to know more?

Visit www.wapa.gov/es/pubs/esb/2004/feb/feb049.htm

Energy Services: An energy-saving tool for all seasons

The groundhog has little influence in the west, where Old Man Winter is just getting started in February and everyone is looking for ways to stay warm at home and work without breaking their energy budgets. Since knowledge is power, Western's Energy Services Web site provides our customers with resources to teach consumers how to control their energy costs during the coldest time of the year—and beyond.

Tools help consumers

Heating and cooling are the biggest line items on electric bills for homes and many non-industrial businesses, but proper equipment maintenance and installation of energy-efficient technology can have a big impact. For example, caulking and weatherstripping, increasing insulation, retrofitting the heating system or just installing a programmable thermostat are effective ways of improving energy efficiency. Determining which measures are most cost effective and best suited to the application, however, can be a confusing proposition.

Web-based Energy Services tools can help utilities assist their customers sort through the options. The Energy Solutions Database offers a vast, searchable library of energy efficiency information on 31 topics, from industrial and agricultural technologies to energy efficient appliances. Visitors can search for specific information using key words like "thermostat." Search categories for residential, non-residential or agricultural applications allow users to tailor information even more.

A search with the key word "insulation" for residential applications yielded three FAQs and 22 sources for articles, fact sheets, Web resources, programs, reports and software on the subject.

The database draws from sources that include the U.S. Department of Energy, state energy offices, utilities, energy industry associations and universities.

After browsing through the Energy Solutions Database, suppose a customer becomes interested in converting from an old propane boiler to a more efficient heating technology. The Heating System Fuel Cost Calculator can help to determine which system will offer the biggest bang for the energy dollar.

The calculator compares the yearly operating costs of two different heating systems based on the efficiency of the heater, the distribution system and the cost of fuel in the area, assuming an equal amount of space to be heated in both cases. Comparing an Energy Star heat pump connected to standard ductwork with that old propane heater using the same distribution system shows that upgrading could cut the homeowner's yearly fuel bill by as much as half.

The values the calculator assigns

Energy Services Web site now has a new look and improved navigation to make useful tools like the Energy Solutions database and the Heating System Fuel Cost Calculator easier to find.

to heater efficiency, distribution efficiency and fuel cost fields are based on averages. Utilities can help users obtain more accurate estimates by supplying fuel costs and information about the current heating system. Actual values may vary significantly from the estimates, but the calculator is a good jumping-off point for making decisions about heating technology.

Online publications inform utilities

New energy saving technologies and strategies are evolving all the time for power suppliers and their residential and commercial customers, and it can be easy to miss a great idea. Energy Services publications can help busy utility managers keep up to date on the latest industry trends.

Readers of the online, bimonthly Energy Services Bulletin know that the newsletter is great for learning about Western customers' energy

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TOPICS from the POWER LINE

Accurate readings needed to assess power factor

Editor's note: The Energy Services Bulletin features real answers to real questions posed to our staff at the Energy Services Power Line. We hope you find it useful.

Question:

How will power factor affect metering in a distribution system?

Answer:

The answer to your first question is slightly different depending whether you are referring to the displacement power factor or the true power factor. The displacement power factor equals the cosine of the phase angle between the voltage wave and the current wave. The true power factor is the ratio of the true RMS real power to the true RMS apparent power, i.e. kW/kVA.

Both methods give exactly the same power factor if no harmonics are present. But if significant harmonics occur in either the voltage or current, the true power factor is lower.

All AC electric meters account for power factor when they register and record real power. Most utility revenue meters only recognize displacement power factor, so they will be accurate only when the real power factor is close to the true power factor. The presence of significant harmonics will tend to cause the power factor to read higher than true power.

To find out if your displacement power factor is different from your true power factor, you can measure both with a high-end power analyzer, such as a Fluke 43B. These analyzers recognize displacement power factor and some will display both true

and displacement power factor. If the readings are very different, it is likely that the true power factor is lower than is what your meter is measuring. ⚡

Want to know more?

Visit www.wapa.gov/es/pubs/esb/2004/feb/feb0411.htm

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efficiency and renewable energy efficiency activities. Consumers are showing more interest in energy efficiency so they may appreciate their utility publishing the Bulletin's URL in their own outreach publications. Energy Newsbriefs, by the WSU Energy Program Library, promotes awareness of emerging trends in the energy industry. The service profiles news from professional journals of interest to utilities and cooperatives.

Another good place to get ideas to promote energy efficiency is the Utility Options database. The database contains actual competitive and marketing projects and programs that public power entities are using to retain existing customers and win new customers, diversify and market their services and deliver their services more efficiently and cost-effectively.

Western encourages utilities throughout the nation to enter their programs in the database so utilities of all types, sizes, resource levels and geographic locations are represented. The information includes the type of project, the sector it addresses, contact information and a summary with links where appropriate. Additional information comes from current utility industry news and publications. Visitors can browse the latest entries or search the database using key words.

In the coming months, look for the Energy Services Web site to refine its look and add useful new information. As sure as winter turns to spring, heating loads become cooling loads, and saving energy is a year-round effort. Western will continue to find ways to help its customers meet any challenge the weather—and the market—can send. ⚡

Want to know more?

Visit www.wapa.gov/es/pubs/esb/2004/feb/feb0410.htm



ENERGY SHORTS

New Web site simplifies applying for federal grants

A new Web site unveiled December 9 by Health and Human Services Secretary Tommy G. Thompson, will make it easier for organizations to learn about and apply for Federal grants.

The site, Grants.gov, provides information in a standardized format across agencies and includes a “Find Grant Opportunities” database that allows applicants to search current funding opportunities. The “Apply for Grants” feature greatly simplifies the application process by allowing applicants to download, complete and submit applications for specific grant opportunities from any Federal grant-making agency.

Secretary Abraham pledges to speed review of energy-saving standards

At a recent meeting with energy efficiency, environmental and consumer groups and major utility companies, U.S. Energy Secretary Spencer Abraham promised to “cut through the red tape” that has delayed the long-awaited reviews of energy efficiency standards on residential furnaces and other equipment.

DOE staff used the meeting to review the steps involved in considering a new standard and discussed ways to smooth the process. The standards under review cover residential furnaces and boilers, commercial air conditioners and electric distribution transformers.

Minnesota wind incentive capacity full

Minnesota’s production incentive for small, utility-scale projects of 2 MW or less completely reached its capacity on Nov. 7, at 9:20 A.M., according to the American Wind Energy Association.

On that date, the Minnesota Energy Office accepted the final project to be eligible for the state payment of 1.5 cent per kWh. The exact time was important, since multiple projects were scrambling to secure power purchases to meet the deadline for the incentive. Developers submitting their applications later in the day missed the opportunity.

Master’s degree offered in alternative fuels

Michigan’s Wayne State University has become the first in the nation to offer a master’s degree program specifically in alternative fuel technology.

The College of Engineering

opened the graduate level course, “Fundamentals of Alternative Energy I” to students with a bachelor’s degree in engineering during the winter semester. The study will focus on many aspects including fuel cell catalysts, thermal management, control systems, smart sensors, process safety, vehicle design, traffic simulation, infrastructure management and engineering management.

California’s self-generation rebate program extended

California’s outgoing Governor Gray Davis signed legislation on Oct. 12, to extend the state’s Self-Generation Incentive Program through the end of 2007. The program that has done so much to stimulate the growth of solar power in California was set to expire at the end of 2004.

The new legislation, Assembly Bill 1685, also set emissions standards and required a minimum conversion efficiency of 60 percent for any fossil-fueled distributed generation that seeks to qualify for the incentive payment. Combined heat and power projects can earn credits against the emission standards based on how much heat they recover. ⚡

Want to know more?

Visit www.wapa.gov/es/pubs/esb/2004/feb/feb04shorts.htm

PV cells *from page 10*

thing like printing or spraying the materials onto a roll of plastic, and then applying it to large surfaces.

The next phase of research will combine the new materials and techniques, with hopes of yielding at least five-percent efficiency. “We think we have pathway for using this and other tricks to get to 10-percent reasonably quickly,” said Forrest.

On the other side of the country, researchers at the Berkeley campus of the University of California are working with nanocrystals of cadmium selenide, a light-sensitive semiconductor. Forbes magazine reported that chemistry graduate students at the university used the material to create a postage stamp-sized solar cell that generates 1.5 milliwatts, or 15 watts per square meter. ⚡

Calendar of events

Feb. 10-18	2004 NRECA Annual Meeting); National Rural Electric Cooperative Association; New Orleans, LA. Contact: NRECA; phone: 800-931-9607.
Feb. 18	Renewable Energy Atlas of Colorado; Colorado Energy Science Center, National Renewable Energy Laboratory; Golden, CO. Contact: CESC; phone: 303-216-2026.
Feb. 18-19	Wind Energy and Rural Development in North Dakota V; Energy & Environmental Research Center; Fargo, ND. Contact: Dee Kraft; phone: 701-777-5068; fax: 701-777-5181.
Feb. 19	Substation 101; Rocky Mountain Electric League; Albuquerque, NM. Contact: Tim Blum; phone: 303-695-0089; fax: 303-695-0704.
March 1-3	Power-GEN Renewable Energy: Cleaning the Air; American Council on Renewable Energy; Las Vegas, NV. Contact: Lisa Gasaway; phone: 918-832-9245.
March 1-3	RESNET Conference 2004; Residential Energy Services Network; San Diego, CA. Contact: Conference Administrator; phone: 760-806-3448; fax: 760-806-9449.
March 7-10	Engineering & Operations Technical Conference; American Public Power Association; San Antonio, TX. Contact: Keenan Carrere; phone: 202-467-2942; fax: 202-467-2910.
March 8-13	Women's Photovoltaic Design & Installation; Solar Energy International; Santa Cruz, CA. Contact: SEI; phone: 970-963-8855; fax: 970-963-8866.
March 14-16	2004 APPA CEO Roundtable; American Public Power Association; Scottsdale, AZ. Contact: Heidi Lambert; phone: 202-467-2976.
March 24-25	Globalcon 2004; Association of Energy Engineers; Boston, MA. Contact: AEE; phone: 770-447-5083; fax: 770-446-3969.
March 24-26	72nd Annual Conference & Policy Makers' Seminar; California Municipal Utilities Association; Monterey, CA. Contact: Ann Linnekens; phone: 916-441-1733.
March 28-31	Global Windpower Conference and Exhibition 2004; American Wind Energy Association; Chicago, IL. Contact: Stefanie Brown; phone: 202-383-2512; fax: 805-654-1676.
April 5-9	Energy OutWest Conference: Thinking Inside the Box, U.S. Department of Energy, Seattle office, states of Alaska, Idaho, Oregon, Washington, California, Arizona, and Nevada; Sacramento, CA. Contact: Washington State University Conferences and Professional Programs; phone: 509-335-3530.
April 13-14	Colorado Wind & Distributed Energy: Renewables for Rural Prosperity; Colorado Governor's Office of Energy Management and Conservation, U.S. Department of Energy's Wind Powering America; Denver, CO. Contact: Megan Castle or Ed Lewis, OEMC; phone: 303-894-2383 x 1211.
April 17-18	SOLFEST Southwest; Solar Living Institute, Kyocera; Scottsdale, AZ. Contact: Andrea Tintle; phone: 480-488-8792.
April 18-21	ICEED's 31st Annual International Energy and 25th Annual International Area Conference; International Research Center for Energy & Economic Development; Boulder, CO. Contact: Dorothea H. El Mallakh; phone: 303-442-4014; fax: 303-442-5042.
April 20-23	Industrial Energy Technology Conference Sempra Energy Solutions, Texas State Energy Conservation Office, USDOE and many more; Houston, TX. Contact: Lana; phone: 979-847-8950.
April 26-30	Empowerment With Power Tools! Women's Carpentry; Solar Energy International; Carbondale, CO. Contact: SEI; phone: 970-963-8855; fax: 970-963-8866.
April 27-30	15th Annual U.S. Hydrogen Conference and Hydrogen Expo USA; National Hydrogen Association; Los Angeles, CA. Contact: Toyya Patterson; phone: 202-223-5547; fax: 202-223-5537.
May 3-14	Women's Photovoltaic Design & Installation; Solar Energy International; Paonia, CO. Contact: SEI; phone: 970-963-8855; fax: 970-963-8866.
May 5-7	24th Annual Utility Energy Forum, Energy Efficiency & Renewables: The First Response Strategy; Western, Bonneville Power Administration & more; Tahoe City, CA. Contact Guy or Linda Nelson; phone: 541-994-4670.
May 16-18	RMEL Spring Electric Energy Conference, Rocky Mountain Electrical League; Ft. Collins, CO. Contact: RMEL; phone: 303-695-0089; fax: 303-695-0704.
June 9-10	Fuel Cell 2004; Fuel Cell Magazine; Denver, CO. Contact: Marsha Hanrahan.
June 12-17	Women's PV Workshop; Midwest Renewable Energy Association, Solar Energy International; Custer, WI. Contact MREA; phone: 715-592-6595.
June 19-23	APPA 2004 National Conference; American Public Power Association; Seattle, WA. Contact: Paulette Kum; phone: 202-467-2941.
July 10-14	A Solar Harvest: Growing Opportunities; American Solar Energy Society, Solar Energy Assoc. of Oregon, Portland, OR. Contact ASES; phone: 303-443-3130; fax: 303-443-3212.
July 23-25	Renewable Energy Fair; SolWest/Eastern Oregon Renewable Energy Organization; John Day, OR. Contact: Jennifer Barker; phone: 541-575-3633.
Aug. 28 - Sept. 3	World Renewable Energy Congress 2004; National Renewable Energy Laboratory; Denver, CO. Contact Ms. Ivilina Thornton; phone: 303-275-378.