



SERC

ENERGY NEWS

Renewable Energy and Energy Efficiency in Kenya Arne Jacobson

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The quarterly newsletter of the Schatz Energy Research Center

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Kenya is a world leader, on a per capita basis, in the utilization of solar photovoltaic systems. Solar power provides the main source of electricity for more than 5% of Kenya's rural population, and sales of solar products in Kenya continue to grow.

Although these high use levels indicate a robust renewable energy sector, quality issues have long been a concern in the Kenya solar market. As is true in many Sub Saharan African countries, market institutions for ensuring quality are weak in Kenya. As a result, while most solar products sold in the country perform adequately, some of the products sold in the market perform well below advertised levels. This persistent presence of low quality goods is a problem not only for rural Kenyans unlucky enough to purchase the "wrong" PV module or battery, but also for the reputation of the solar industry.

SERC faculty member Arne Jacobson has been involved in efforts to address and correct quality problems in the Kenya solar market since 1999. This ongoing work has involved field and laboratory testing of solar modules from the Kenya market over a number of years, as well as collaborative efforts to build quality assurance mechanisms for solar products sold in the country. The results of this work, including a successful effort in 2004/05 to remove the lowest performing modules from the market, are chronicled in a recent article titled "Engineering, Institutions, and the Public Interest: Evaluating Product Quality in the Kenyan Solar Photovoltaics Industry." The article, which was published in the Energy Policy journal in 2007, was co-authored by Jacobson and Daniel Kammen of the University of California, Berkeley. (A PDF version of this article is available at www.schatzlab.org/publications.html.)

SERC is now engaged in a parallel effort associated with the emerging use of high efficiency off-grid lighting systems based on white light emitting diode (WLED) technology. This work, which involves collaboration with Evan Mills of the Lawrence Berkeley National Laboratory (LBNL), includes laboratory testing of a number of WLED product lines, as well as field work and collaborative discussions with partners *(continued on page 2)*



Arne Jacobson of SERC helps Daniel Buyu of Yala, Kenya troubleshoot a problem with an LED flashlight. Photo by Evan Mills.

A Message from the Director

Peter Lehman

Humboldt County has become a hotbed of renewable energy development. We've reported in a past issue that Humboldt County residents have the highest per capita use of grid-connected solar systems in California, even though our amount of sunshine is less than in southern areas. Now things have intensified, with large corporations getting in on the Humboldt drive to switch to renewables.



The Schatz Center recently hosted a visit from Tim O'Leary and his colleagues from Shell Renewables and Hydrogen. Shell has begun the process of developing a wind farm on Bear River Ridge, just inland from Cape Mendocino and one of the best wind sites in the western U.S. Local ranchers are enthusiastic as they see wind farming as a way to gain revenue and keep their generations-old ranches active and thriving. Pacific Gas and Electric Company has announced that they'll begin prospecting off the Humboldt County coast for wave energy potential. North coast wave energy could make a huge contribution to renewable energy in California. DG Energy is looking to increase its use of wood chips and other woody biomass to produce electricity; Humboldt County already gets almost 50% of its electricity from wood. And here at the Schatz lab, we've begun a partnership with Forestry faculty and the Schatz Tree Farm (yes, it's the same Mr. Schatz) to study gasification and pyrolysis of woody biomass. We're aiming to get biomass out of the forest and producing useful energy. This has a large potential to produce renewable energy in the West as fuel reduction efforts in our national forests will supply biomass for decades to come.

Meanwhile, as I write this, my colleague and SERC co-director, Arne Jacobson, is halfway around the world in Kenya beginning work on a LED lighting project. Arne reports on his work in our cover story in this issue. We also report on our outreach efforts in three remote schools in the Yurok Reservation and our efforts here in town to help the United Indian Health Services facility go solar. Finally, there's a note about the upcoming North Coast Energy Alternatives Conference sponsored, in part, by SERC. It should be a lively day as we discuss how to make Humboldt cleaner and greener.

I'm writing this on the summer solstice. Happy summer to all of you. May your days be filled with fun, adventure, and plenty of solar energy.

Energy in Kenya (continued from page 1)

in Kenya.

The emergence of WLED technology for off-grid applications in places like Kenya is linked to a sharp decline in prices combined with a similarly dramatic increase in the electricity to light conversion efficiency of the devices. The resulting off-grid lighting systems are viewed increasingly as potential substitutes for the fuel based lighting systems that are used commonly in Sub Saharan Africa and elsewhere around the world.

Lighting systems based on this emerging technology have the potential to provide superior lighting services at prices that are affordable to many in off-grid areas of developing countries. In cases where WLEDs are used as a substitute for kerosene lighting, the technology also has the potential to provide significant health and environmental benefits in the forms of improved indoor air quality, reduced fire hazards, and – perhaps – lower greenhouse gas emissions.

While the potential for beneficial uses of WLED technology may be promising, the challenges that must be overcome to realize this opportunity are significant. One important issue involves efforts to ensure the quality of off-grid lighting systems based on WLED technology. This is important both to protect those who purchase off-grid lighting systems from fraud and to avoid problems of "market spoiling" in which the reputation of all WLED products are damaged by the presence of some low performing devices.

SERC's initial work in this area will be outlined in a set of forthcoming publications that will be available from www.schatzlab.org/publications.html.

North Coast Energy Alternatives Conference

SERC is proud to be a sponsor of the North Coast Regional Energy Alternatives Conference. The conference is being put on by Plan It Green, a local non-profit organization composed of engineers, planners, builders, architects, and other professionals dedicated to green community planning and design. The conference will be an all day event on Saturday, June 23rd from 9 AM to 5 PM at the Arcata Community Center. The conference will focus on energy alternatives for Humboldt County, and will highlight the many opportunities we have for energy efficiency and renewable energy here on the North Coast. Presentations will be categorized into three concurrently running tracks: 1) large scale energy infrastructure; 2) small scale energy technologies; and 3) green buildings and energy efficiency and conservation.

The keynote speaker for the conference is Paul Fenn, author of California's 2002 Community Choice Aggregation law (AB 117). Other featured speakers include: Timothy O'Leary from Shell WindEnergy speaking on Shell's proposed wind project at Bear

(continued on page 3)

SERC Helps United Indian Health Services Go Solar

Local health care provider United Indian Health Services (UIHS) recently received a grant from the State of California to install a 40-kW solar electric power system on the rooftops of two wings of UIHS's Potawot Health Village here in Arcata. SERC assisted UIHS in developing a conceptual design for the system and writing their grant proposal. Once UIHS received funding, they retained a professional solar contractor to install the system and hired SERC to help them with other aspects of the project.

For starters, we are developing interpretive materials to explain how the system works and promote renewable energy. The display SERC is developing will include an interactive computer display showing how much power the system is producing in real time, as well as a static display sign and a brochure visitors can take with them. UIHS wants these interpretive materials to convey to its clients and staff the connections between clean energy, health, and Native American values of living sustainably on the land.

SERC will also help UIHS with quality assurance, making measurements to ensure the solar system is generating as much power as it should. Finally, we will provide a training workshop for the UIHS community at large to increase understanding of clean energy resources and encourage greater use of these resources among Tribes in northwestern California.



Solar panels atop the maintenance wing of the UIHS facility. *Photo courtesy of UIHS.*

Conference (continued from page 2)

River Ridge; Greg Lamberg from Pacific Gas and Electric Company presenting on PG&E's proposed repowering of the Humboldt Bay Power Plant and their plan to study wave power in Humboldt County; and Pat King of DG Energy discussing DG Energy's biomass energy projects. SERC will also feature speakers at the conference, including Jim Zoellick delivering the plenary address, Michael Winkler speaking on renewable energy scenarios for Humboldt County, Peter Johnstone presenting on SERC's hydrogen power park project, and Stephen Kullmann discussing the economics and environmental impact of refrigerator replacement.

Outreach on the Klamath

This past spring, SERC visited three elementary schools on the Yurok Reservation: Weitchpec Elementary, Margaret Keating School, and Jack Norton School. The goal was to inspire and teach Yurok youth about basic energy concepts, renewable energy technologies, and energy efficiency. The events were part of a community-wide energy education campaign for SERC's "Human Capacity Building in Energy Efficiency and Renewable Energy" project with the Yurok Tribe.

Our elementary energy curriculum starts with a primer on what we mean by "energy" and "power" and where energy comes from. We then explain how renewable energy is different from conventional energy sources, and provide real-world examples of renewable energy through discussing some of the renewable energy projects we are involved in at SERC.

Once the foundation of energy concepts are laid, we play our power consumption guessing game called "Watts Up?" to help the students understand energy use. In the game, teams of students have the task of guessing how much power typical home appliances consume. The appliance is plugged into a power meter, turned on, and the team that was closest gets a point. In addition to the inevitable surprises we get from the difference between a radio and a toaster (4 W vs. 1000 W), "Watts Up?" gives students the opportunity to do math and convert watts of power to watt-hours of energy. Finally, we challenge students to put renewable energy in action by building their own solar electric circuits that power buzzers and fans. This hands-on activity is a fun way to end the lesson and for students to get first hand experience making solar energy work, even when it is cloudy like it was at Margaret Keating School. Luckily for the Jack Norton school children, it was sunny enough to demonstrate a solar oven, and we cooked cinnamon rolls during the outside activities. The oven was able to reach temperatures of 250 °F and cooked the rolls in about 45 minutes. After lunch, we shared our solar powered dessert with the whole school; it was a big hit.

It is heartening to see how students think about energy. In particular, the students at Jack Norton School have a unique perspective on energy, as all the students live off the grid. And, in addition to providing students the tools they need to think about energy efficiency and conservation, each student was given a compact fluorescent light bulb (one of the "Watts Up?" appliances) and energy information brochures so that they could put into practice at home what they learned in the classroom.

"The whole team was surprised that the twirly light bulb was only 14 watts..." (Thank you letter from a Margaret Keating School student.)



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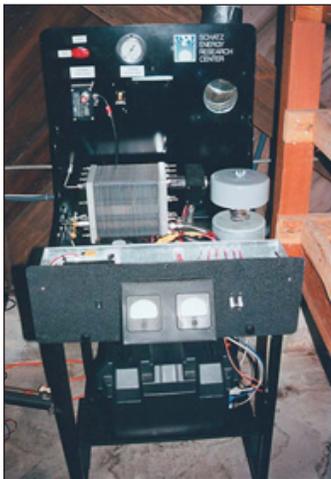
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Looking Back

8 years ago SERC installed a fuel cell backup power system for a telecommunications station on a remote mountain-top in the Redwood National and State Parks. The station provided telephone service to the Yurok Indian Reservation in the Klamath River Valley. During the day, the station's microwave repeater was powered by solar panels and the excess energy was stored in batteries. Over long periods of cloudy weather when there was not enough sun and the batteries ran down, the fuel cell generator turned on and provided power for the repeater. The system went online in October 1999 and was retired from service in May 2003 when landline telephone service was installed at the reservation, making the microwave repeater system obsolete. In all, the system logged over 8,000 hours of runtime. For more information visit www.schatzlab.org/schoolhousepeak.html.



SERC Energy News is published quarterly by the Schatz Energy Research Center at Humboldt State University.

The mission of SERC is to promote the use of clean and renewable energy in our society. SERC meets its mission by performing research and developing new technology; designing, building, operating, and demonstrating clean and renewable energy systems; providing training for professionals; and educating the public about a sustainable energy future. SERC's affiliation with the Environmental Resources Engineering program at HSU provides a rare opportunity for undergraduate and graduate engineering students to acquire hands-on experience with cutting-edge energy technologies.

SERC is a member of the National Hydrogen Association, the International Association for Hydrogen Energy, the International Solar Energy Society, and the American Solar Energy Society.

SERC co-directors are Peter Lehman, Charles Chamberlin, and Arne Jacobson. Research and administrative staff include Andrea Allen, Greg Chapman, Ranjit Deshmukh, Richard Engel, Ray Glover, Peter Johnstone, Stephen Kullmann, Judith Louise, Marc Marshall, Allison Oakland, Mark Rocheleau, Scott Rommel, Michael Winkler, and Jim Zoellick.

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