



# SERC ENERGY NEWS

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HUMBOLDT STATE UNIVERSITY

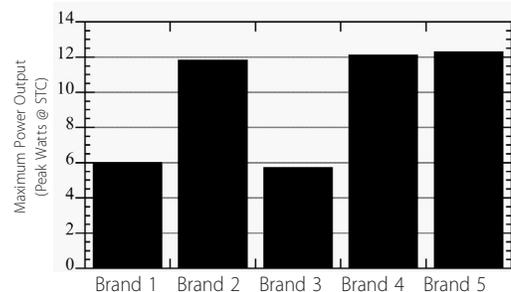
## Building Institutions for Renewable Energy Markets: Quality Assurance Testing of Solar Modules in Kenya

Arne Jacobson

Renewable energy can be a pillar of a sustainable future in industrialized and developing countries alike. Over the past decade renewable energy has moved from the margins into the mainstream, as commercially viable markets have emerged in a number of countries around the world. However, the sustainability of these new markets is not guaranteed. Market institutions that ensure quality and protect consumer interests are critical to support and expand renewable energy markets.

Kenya has one of the largest markets per capita for solar electric systems among developing countries, but it has been plagued by quality problems and even fraud. For example, while many of the solar module brands sold in Kenya perform adequately, some companies have sold low quality products that produce only a fraction of their rated power output. See the graph at right showing test results for five competing brands of 14 Watt rated solar modules sold in Kenya for an illustration of these problems.

In some cases the low performing brands have managed to persist in the Kenya market for years. Their "success" is due to an absence of effective regulatory institutions, and in part because the rural Kenyans who buy solar electric systems have had little access to reliable information about the relative quality of competing brands. These problems have created reputation problems for solar technology, and almost certainly have slowed the expansion of the market.



Average Stabilized Maximum Power Output for Five Brands of 14 Watt Rated Amorphous Silicon Solar Modules Sold in Kenya. (Maximum Power at Standard Test Conditions of 1000 W/m<sup>2</sup> and 25°C).



Solar module performance testing atop SERC's rooftop solar laboratory. Photo by Kellie Brown

Over the past several years we at SERC have worked with colleagues from Kenya and the University of California, Berkeley to create solutions for these quality and market development problems. We have combined engineering expertise with creative policy approaches to ensure the quality of all modules sold in the market. At the heart of our approach is a low cost method for measuring the field performance of solar modules. Our work has already made a difference - some of the lowest performing brands have been withdrawn from the market as the result of our efforts.

(continued on page 3)

## A Message from the Director Peter Lehman

Early in May, we were fortunate to host a visit from California's Climate Action Team. The team was here to discuss the role of forests in mitigating climate change and to take input from attendees on the state's Climate Action Plan. The plan is well researched and well written and its very existence puts our state far ahead of our nation in addressing climate change. Energy efficiency, conservation, new technologies, and a carbon trading system are among the important and effective strategies promoted by the plan. In my response to the team, I pointed out that despite the plan's quality, the most important message about climate change had been omitted. It is this: All of these strategies taken together won't solve our problems without a reduction in our wasteful lifestyle. That's a message we at SERC try to stress: Technology, no matter how clever and effective, won't solve our problems by itself. We have to change too.

We continue working to get our message about clean and renewable energy out there. Our HyTEC hydrogen energy curriculum has been tested in local high schools and has been a rousing success. Our energy capacity building program with the Yurok Tribe is now in full swing and we are again working with Redwood National Park in the University- National Park Energy Partnership Program. Two HSU undergraduate engineering students will install a solar electric system this summer, which replaces an inefficient, noisy, and polluting diesel generator at a ranger residence. And our technology work continues as well, as Arne Jacobson describes in his article about photovoltaic testing.

With energy prices stubbornly high and our president finally saying out loud that "We're addicted to oil," it's a great time to be working in energy. I hope you enjoy reading about our efforts.



## Annual Speaker Series on Energy, the Environment, and Society Arne Jacobson

Energy is a vital element of some of the most important and most divisive processes of our times. The widespread use of fossil fuels provides the foundation on which economic globalization is taking place. At the same time, the use of these fuels is a central cause of global climate change, which may prove to be the single largest environmental issue that we face today. Studies of fossil fuel resource availability indicate that world oil production may peak within the next decade, even while demand for the fuel continues to rise. As a result many scholars foresee increasing possibilities for resource conflicts as well as rising fuel prices. Renewable energy and energy efficiency have significant potential to contribute to solutions for some of the environmental, economic, and security problems associated with current trends in world energy use, but many barriers currently limit the widespread use of these technologies. The path towards progressive solutions to these issues requires an interdisciplinary approach that combines technical and scientific expertise with economic, social, and political analyses.

To shed light on these crucial issues, SERC initiated an annual speaker series to bring a dynamic set of presenters to Humboldt State University. The series includes leading scholars from a range of academic disciplines, as well as prominent government officials and inspiring activists. Featured speakers in the 2005/06 series, our first annual, included Dr. Alan Lloyd, Secretary Emeritus of the California Environmental Protection Agency and Chair of California's Climate Action Team, Dr. Joan Ogden, Co-Director of the Hydrogen Pathway Program at the Institute of Transportation Studies at UC Davis, and Dr. Michel Gelobter, Executive Director of the environmental non-profit Redefining Progress. Also presenting were Mark Hankins, the Managing Director of Energy for Sustainable Development Africa (ESDA), a Nairobi based energy consulting firm, Jim Zoellick of SERC, and Dr. Arne Jacobson of SERC and the Environmental Resources Engineering Department at HSU.

SERC has a diverse line-up of speakers scheduled for the 2006/07 series that will continue the exploration into the vital role energy plays in our lives. Visit [www.schatzlab.org/speaker\\_series](http://www.schatzlab.org/speaker_series) to stay apprised of this exciting series.



Dr. Alan Lloyd addresses panel and audience members during the first public meeting of California's Climate Action Team, held at HSU. Dr. Lloyd spoke later that evening on air quality issues for SERC's speaker series.

# SERC Delivers Fuel Cell to San Luis Obispo

The Materials Engineering Department at CalPoly San Luis Obispo (SLO) recently purchased a 140 cm<sup>2</sup> single cell fuel cell that was designed and produced at SERC. Delivery of the cell to the department occurred last May, but our job did not end there; to facilitate SLO's foray into fuel cell research, SERC engineer Antonio Reis provided technical expertise and insight into fuel cell research issues by installing and demonstrating the operation of the fuel cell to department faculty and student researchers. Technology transfer to other universities is an important method SERC uses to contribute to the fuel cell research and development arena.

# First-Ever Schatz Energy Fellow Announced

SERC recently awarded the first ever Schatz Energy Fellowship to Ranjit Deshmukh, an incoming HSU student who will begin the Environmental Systems Graduate Program in Fall 2006. Although SERC has supported graduate students in the past, from student assistant positions to financial support such as tuition, co-directors Peter Lehman and Charles Chamberlin and Environmental Resources Engineering (ERE) Assistant Professor Arne Jacobson decided the time had come to make SERC's support and commitment official. The fellowship aims to attract high caliber graduate students in the ERE and International Development Technology (IDT) options of the Environmental Systems Graduate Program who intend to focus on renewable energy or energy efficiency related work. The fellowship provides \$10,000 in support during the academic year and may be renewed once to cover a second year of graduate study. The fellow is expected to participate in research activities at SERC during the nine-month academic year. Ranjit comes to SERC with a BS degree in Mechanical Engineering from the Government College of Engineering in Pune, India, and an MS degree in Manufacturing Systems Engineering from the University of Texas at Austin.

## ..... Solar Module Testing (continued from page 1) .....

Recent performance tests at SERC's rooftop solar laboratory indicate that low performing solar modules are also being sold in North American markets. In the coming months we will release a study on the performance of 15 Watt rated amorphous silicon solar modules sold by major internet retail outlets.

The creation of quality assurance mechanisms is a crucial component of renewable energy market development in countries from Kenya to the United States. Success depends on innovative solutions that build on and strengthen existing market institutions, and that employ engineering approaches that are appropriate given the resource constraints of each country. Success also requires a long-term commitment to renewable energy market development, and much work remains in Kenya, the U.S., and elsewhere. We at the Schatz Energy Research Center at Humboldt State University are committed to the task.

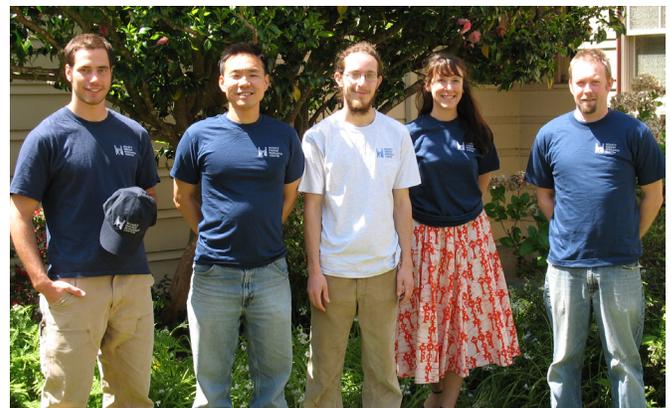
## Docent Corner Allison Oakland

### Watts Up?

What's the difference between energy and power? What's a "Watt?" These are some of the questions students explored during SERC's "Got Energy?" workshops at the annual Redwood Environmental Education Fair (REEF).

Each spring, elementary and middle school students throughout Humboldt County converge for two days to learn about environmental education. SERC has participated in this event since 2001. Workshop attendees played "Watts Up?", an interactive game that motivates students to explore the difference between energy and power and inspires them to think about the use of energy in their lives. Workshops culminated with a solar electric circuit activity that challenged students to discover how to sound a solar powered buzzer. Students were excited about this activity; many of them asked how to get their own solar panels and buzzers in order to pursue solar energy and power at home.

Over 170 students discovered the power of renewable energy and energy efficiency during SERC's REEF workshops. In total, our outreach program reached over 1700 students this past year. We look forward to another successful year of outreach when our program resumes in the fall.



2005-2006 docents (left to right) Eric Zielke, David Kang, Colin Ritter, Melissa Caldwell, and Kevin Fancher.

### A Word From... Eric Zielke

“ I want to thank SERC and HSU's Renewable Energy Student Union (RESU) for initiating the docent program in the Spring of 2004. This program allows HSU students to gain real world renewable energy experience. I am honored to support SERC through my participation as a docent. I believe that one of the most important aspects of renewable energy applications is the ability to teach people not only the intricacies of how particular renewable energy systems work, but also how renewable energy applications can further our nation's progress toward decreasing its dependence on foreign oil. ”



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## Looking Back

**6 years ago** the Schatz Hydrogen Generation Center, located in Thousand Palms, CA, became one of the first complete hydrogen production, compression, storage, and dispensing facilities in the U.S. The facility provided compressed hydrogen at 3600 psig for use in the hydrogen fuel cell powered vehicle fleet built by SERC and operated by SunLine Transit Agency and the City of Palm Desert. The hydrogen generation center was designed and installed by SERC engineers and is operated and maintained by SunLine Transit personnel. At present, the generation facility is operating for demonstration purposes and two of the four fuel cell vehicles are in use. For more information visit [www.schatzlab.org/generationcenter](http://www.schatzlab.org/generationcenter).



**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 and Charles Chamberlin. Research and administrative staff include Andrea Allen, Greg Chapman, Richard Engel, Ray Glover, Anand Gopal, Arne Jacobson, Peter Johnstone, Marc Marshall, Erin McDonald, Allison Oakland, Antonio Reis, Mark Rocheleau, Scott Rommel, Douglas Saucedo, Matthew Smith, Michael Winkler, and Jim Zoellick.

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