



SERC

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Features

Efficient Off-Grid Lighting
in Kenya

"Bagasse Across America"
Road Trip

In Every Issue

A Message From
the Director

Project Updates

Looking Back

The quarterly newsletter of the
Schatz Energy Research Center

HUMBOLDT
STATE UNIVERSITY

Efficient Off-Grid Lighting in Kenya

Peter Johnstone

We continued our research on efficient lighting for sub-saharan Africa in winter 2009 as a continuing partner in the Lumina Project, a collaboration between SERC Co-director Arne Jacobson and Evan Mills of Lawrence Berkeley National Laboratory. Over a month-long trip in summer 2008, Dr. Jacobson, Kristen Radecsky, and I traveled in the Rift Valley region of Kenya doing market field testing of small, rechargeable LED lighting products. In January 2009, I returned to the field for two weeks to follow up with the study participants and wrap up the year's data collection effort. The January tasks included a follow-up survey for night market vendors who participated in the study, surveying the demand threshold for illumination for the vendors, and gathering samples of LED products that are available in the Kenyan marketplace.

Between July 2008 and January 2009 our research participants had 6 months to work with the LED lamps they purchased through our project, and their response to the technology has been very positive. M.J., a research participant in the town of Maai Mahiu says, "I stay open longer now than before. I've noticed more customers are attracted to my business in the evening compared to before, and they can see my goods more clearly. More customers means more sales and more money for me. Some people come from far [out of their way] to see the lamp, [due to the novelty of the lamp.]" Other research participants have observations such as: "...since I bought it I have stopped using kerosene." "[The LED lamp is] safer than kerosene lamps in terms of fire, glass breaking, and other things." Follow up surveys confirmed what we knew anecdotally to be true, that introduction of LED lighting helps people reduce their consumption of kerosene for lighting.

The results of our research are extensively reported on the Lumina
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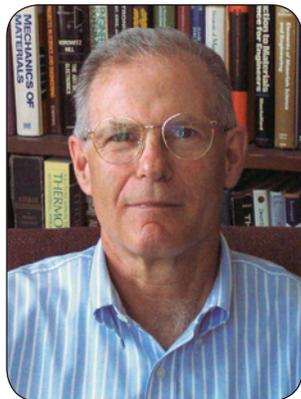
"Before": M.J., a vendor in the Kenyan town of Maai Mahiu, poses with his hurricane-type kerosene lamp inside his kiosk.
"After": M.J. with his LED lamp that he obtained through our research effort.



A Message from the Director

Peter Lehman

Over the years I've given numerous talks about energy to audiences ranging from university students to citizen groups. Whenever I speak about the renewable energy future that we must someday achieve, a frequent question is, "What do we need to get there?" My answer has always been, "The most important thing we need is political leadership at the top."



About two months into the Obama administration, we finally have that leadership. The President has recognized and has said out loud numerous times that energy issues are crucial to our economic health and our national security. He has proposed increased energy efficiency standards, a cap and trade system to address carbon emissions, and a 10 year, \$150 billion investment in clean energy, among many other proposals. His goals are ambitious, too ambitious say some, in light of the host of problems we all face, but we at the Schatz Center applaud him for his vision and his courage. It's about time our nation has a forward looking energy policy and we wish the President and DOE Secretary Steven Chu luck in moving their agenda forward.

Here at home, our long awaited building project to construct a new Schatz Center has begun. Check out the pictures in this issue and you'll see some progress, though things look pretty barren right now at the newly cleared site. We've mounted a camera on the third floor balcony of a neighboring building and are taking time lapse pictures of the construction as it progresses. The pictures here are taken by that camera; our most recent pictures are on our web site.

This issue includes an account by Peter Johnstone of his trip to Kenya for the Off-Grid Lighting Project. Frequent contributors Richard Engel and Jim Zoellick provide updates on projects they manage, Richard on the Hydrogen Energy in Engineering Education Project and Jim on the Yurok Wind and Hydro Feasibility Study. And grad student Joe Purdon reports on one of SERC's more far flung adventures to date. To procure the right type of bagasse for our gasifier work, Joe and SERC engineer Mark Rocheleau flew to Texas, loaded up a rental truck, and drove their 3-ton payload back to Arcata, a trip dubbed, "Bagasse Across America."

The plum tree in my back yard is celebrating the equinox by blooming its heart out. As the sun returns again to our northern hemisphere, here's wishing you all a sunny and productive spring season.

Off-Grid Lighting (continued from page 1)

Project website at <http://light.lbl.gov>. Some highlights include:

- Those who purchase LED lighting don't generally switch completely away from kerosene for lighting; they tend to only reduce their kerosene consumption by augmenting their current fuel based lighting technology with an LED option as it is appropriate. The implications for greenhouse gas reduction projects focused on distribution of LED lighting technology in developing countries is that one cannot make the assumption that fuel-based lighting devices are completely "replaced" by LEDs when efficient lighting is introduced.
- The research participants we worked with generally allow their lamp to get very dim (2 Lux at 1 meter) before they recharge them, contrary to assumptions about demand for lighting that are based on occupational lighting requirements from industrialized countries.



A kiosk in which both LED lighting and fuel based lighting are used for illumination.

Our research going forward through 2009 will expand on the market testing we completed over the last year, investigate indoor air quality implications of fuel-based lighting replacement, and include broader work with consumers, manufacturers, and distributors of LED lighting products. We are also expanding our work with the Lighting Africa Project, an initiative by the World Bank Group to develop the market for off-grid lighting technologies that are tailored to the needs of end-users in Africa. Overall, our efforts through the Lumina Project and Lighting Africa have positioned SERC as a technical and field research leader in the initiative to cultivate and grow a sustainable market for efficient off-grid lighting products in developing countries.

"Bagasse Across America" Road Trip

Joe Purdon

As part of SERC's ongoing gasification research, we are investigating the feasibility of gasifying bagasse on behalf of the Indonesian Sugar Group (see our Summer 2008 newsletter). After sugar and molasses have been extracted from sugarcane, bagasse is what remains of the cane. Sugar mills normally burn bagasse to generate electric or thermal energy. Gasification is potentially a cleaner and more efficient way of producing energy with this agricultural byproduct.

There are no sources of bagasse in California, so we looked elsewhere. Rio Grande Valley Sugar Growers, Inc. in Santa Rosa, TX, agreed to supply us with some of their excess bagasse. However, we quickly learned that getting a fresh load of this waste material hauled by a commercial trucker across state lines to California would be a logistical and regulatory nightmare. It was time to travel to Texas ourselves to pick up our bagasse.

SERC engineer Mark Rocheleau and I flew to Brownsville, Texas on March 3rd. The next morning, we rented a 26-foot U-Haul truck and met a Texas Department of Agriculture inspector at the sugar mill. To ensure pest-free material, we selected fresh bagasse straight out of the crushers. The inspector certified that the bagasse was free of fire ants, sugarcane borers, and weevils and provided us the regulatory papers we would need to bring the material into California. Mill workers helped us load 6,300 lbs. of bagasse onto the truck in 30 pallet-sized bulk bags. Mark and I then drove 2,500 miles back to Arcata over four days.

We are now in the process of drying the bagasse for storage while we make arrangements to pelletize or briquette the material for gasification. Look for an update on the continuing bagasse adventure in our next issue.



SERC graduate student research assistants Meg Harper and Joe Purdon sun-dry the fresh bagasse after unloading it from the rental truck.

Project Updates

Yurok Wind and Hydro Feasibility Study Jim Zoellick

SERC is working with the Yurok Tribe to examine the feasibility of developing hydro and wind power resources on the Yurok Reservation. SERC and Yurok Tribe staff recently installed gauging stations on Ke'Pel and Pecwan Creeks. These stations provide continuous monitoring of stream elevation. Periodically we visit the sites and measure stream flow. We will use this information to develop stage-discharge curves for the two creeks. The stage-discharge curves will allow us to convert the continuous stream elevation data into flow data. We are also installing rain gauges at each site. We plan to use precipitation data to help us correlate the data for these two streams with other streams in the area for which there are long-term stream flow and precipitation data records.



HSU graduate student Jenny Tracy and Yurok Tribe Planner Austin Nova measure stream flow at Pecwan Creek.

This spring we will also be installing a wind monitoring tower on McKinnon Hill. The Tribe has obtained a 50-meter meteorological tower from the National Renewable Energy Laboratory's Native American Anemometer Loan Program. It will be used to collect wind speed and direction data for a period of one year. We will attempt to correlate the McKinnon Hill data with long-term wind speed data from nearby locations. By the spring of 2010 we expect to have sufficient data to complete our feasibility analyses, including an examination of the technical potential for wind and hydroelectric power production, as well as an assessment of the economic feasibility of such projects.

University Hydrogen Curriculum Richard Engel

SERC's Hydrogen Energy in Engineering Education (H₂E³) project continues to pick up steam. We are now building the first of the two fuel cell test stations we will make for use in undergraduate engineering labs. The stations will be temporarily installed on a rotating basis at California State University and University of California campuses over the next two years. After surveying available fuel cells from commercial suppliers, we decided to

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build our own stacks for use with the test stations. The stations and stacks will be completed during the coming months.

Meanwhile, we are finalizing our prototype design for an advanced version of the benchtop electrolyzer/fuel cell experiment kits we originally developed for use in high school chemistry classes. Two dozen of these kits will be produced, also for shared use among California's university campuses. In parallel with hardware development, we are writing our first lesson plans, for use in introductory engineering courses.

We will be sharing our progress on all aspects of this Department of Energy-funded project at the DOE's upcoming Hydrogen Program Annual Merit Review and Peer Evaluation meeting in Washington, DC in May.

The project also has a new logo, shown below. This logo will be used to brand the project, appearing on all H₂E³-related hardware and documents.



Looking Back

7 years ago SERC provided a built-to-order fuel cell test station for the laboratory of Professors Anna Stefanopoulou and Huei Peng of the University of Michigan's Department of Mechanical Engineering. SERC also provided the university with a 1.25 kW 24-cell PEM stack for use on the test station. SERC has built several test stations for in-house fuel cell testing, but this project was our first venture in building a test station for an outside client. UM's engineers were pleased with the results. "I am really impressed by the quality of the test station," noted Prof. Peng. "In Greece we use the word 'meraki' to describe such good craftsmanship," added Prof. Stefanopoulou. For more information visit www.schatzlab.org/projects/research/fcRnD/univ_michigan.html.



New SERC Building



A view of the new building site before construction began, above, and a snapshot of the current building site as taken by a camera mounted on an adjacent building, below.



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, James Apple, Greg Chapman, Richard Engel, Ray Glover, Meg Harper, Peter Johnstone, Patricia Lai, Marc Marshall, Allison Oakland, Joe Purdon, Kristen Radecky, Mark Rocheleau, Scott Rommel, Colin Sheppard, Alina Taalman, Jennifer Tracy and Jim Zoellick.

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