



SERC

ENERGY NEWS

Off-Grid Lighting Adventure Continues

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The quarterly newsletter of the
Schatz Energy Research Center

HUMBOLDT
STATE UNIVERSITY

Despite dust storms stirring up eye-stinging grits of dirt, downpours that filled 50 gallon barrels and donkeys that reverberated piercing 6 AM wake up calls, it was impossible for us not to smile with gratitude and joy. For the second summer running SERC personnel traveled to Kenya to continue our ongoing field research on off-grid, efficient lighting for low income rural people. With help from our Kenyan research colleague Maina Mumbi and the hospitality of his family, SERC Co-director Arne Jacobson, Research Engineer Peter Johnstone and myself, Graduate Student Research Assistant Jenny Tracy, had a successful trip that was never short of excitement--within 15 meters of two full-grown lions we got a flat tire!

Assistance to the World Bank Group's Lighting Africa program and work on the Lumina Project, a collaborative effort between SERC and Evan Mills of the Lawrence Berkeley National Laboratory, were the foci of our trip. Upon our arrival into Nairobi, we participated in a Lighting Africa-sponsored workshop on the importance of product quality assurance. At the workshop we worked with Chinese manufacturers, European and American aid organizations, African government officials, and other stakeholders in the African off-grid lighting market. Beyond the workshop we pilot tested a baseline market presence study with an end goal of surveying approximately 25-30 towns of varying size throughout Kenya. The study will document the market presence of LED lighting products and will serve as a reference point for future analyses of the long-term changes taking place within the off-grid lighting market in Kenya.

Our task this year for the Lumina Project was to extend on our market testing of high-quality, low-cost LED lighting products. With a concerted team effort, on June 8, 2009 the doors opened to one of the first shops in Kenya selling affordable, high-quality LED lamps to off-grid users. The shop is located in Maai Mahiu, a small town of 10,000 people, and is currently being managed by Maina with assistance from Samuel Chege, a recent high school graduate who is now working as the shop's sales person. The shop is offering five different LED lamp models made by two different manufacturers, D.Light and Barefoot Power, with prices ranging from 1000 to 3500 Kenya shillings (Ksh), approximately \$13-46. Six of the lamps for sale are outfitted with data-logging devices designed by SERC engineer



Top: Flashlights, along with other goods, available from hawkers on the street in central Kericho, Kenya.

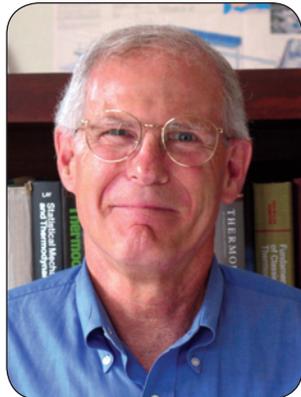
Bottom: Research colleague Maina Mumbi talks to a group of people at the Karagita town market about the new LED lighting products available at the shop.



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A Message from the Director Peter Lehman

The Schatz lab celebrated its 20th year anniversary with a gala picnic and reunion last month. The food was delicious, the fog lifted just in time, and Schatzers new and old got to enjoy a wonderful afternoon at Freshwater Park. Check out the pictures in our "Looking Back" feature of this newsletter.



So much has happened since that first phone call with Mr. Schatz and the first meeting that Charles and I had to plan the Schatz Solar Hydrogen Project. At last count, 77 people have worked and studied at SERC. SERC alumni have gone on to become professors, fuel cell researchers, engineers of all sorts, and energy aware citizens. We've developed the first PEM fuel cell car, two patents, and three still-running licenses for our technology. Soon, our new 6600 square foot lab and office building will be complete and we'll have our dream home for decades to come. Never in my wildest dreams could I have imagined this 20 years ago, but I feel fortunate to have had so many wonderful people as colleagues and that we have accomplished so much to promote clean and renewable energy.

Meanwhile, back at the lab, things are buzzing. Jenny Tracy reports on her work with Arne Jacobson researching energy efficient LED lighting in Kenya. The fieldwork done by Jenny and Peter Johnstone had some exciting moments. Andrea Allen reports on our progress with the HyTEC curriculum we've developed with Lawrence Hall of Science. HyTEC is about to go national and the experiment kit we developed will be marketed by LabAids, a New York company specializing in science materials for high schools. Jim Zoellick reports on our efforts to educate government leaders about hydrogen technology and its opportunities and Jim also reports on raising a 50 meter meteorological tower on the Yurok Reservation for wind energy measurements. Jim and the crew had plenty of exciting moments too.

As the equinox passes and the leaves turn, we hope you enjoy reading about our news as we head into our next 20 years.

"We only have time to do our jobs and the torches [flashlights] that are sold here are the only options we have. We are all very thankful that you have come to help us get better lights." Alex Muasya Kioko, a night watchman from Maai Mahiu.

Hydrogen Learning for Local Leaders Jim Zoellick

Part of SERC's mission is to educate people about clean and renewable energy. To that end, SERC is working on a US Department of Energy funded project to inform local government leaders about the long-term benefits and near-term realities of hydrogen and fuel cell technology. SERC is partnered with the Technology Transition Corporation, who founded and manages the National Hydrogen Association, and the Public Technology Institute (PTI), which assists local government with technology development and implementation. To date, SERC has developed a curriculum and delivered it at PTI's annual conference in San Diego, as well as via a webinar hosted by PTI. In the coming year we will make additional conference and webinar presentations while also developing and implementing a train-the-trainer component to the project. This will increase our effectiveness at getting the word out about hydrogen.

Off-Grid Lighting Adventure *(continued from page 1)*

Scott Rommel and consultant Kyle Palmer. The data loggers will record when the lamp is turned on and when it is being charged, providing detailed data on consumer use patterns. To date 20 lamp products have been sold and hundreds of people have shown interest in the improved lighting products we're offering. It has been interesting to observe how factors affecting people's lives appear to be influencing sales. After a long-anticipated heavy rainfall in early July, maize production thrived and more money was seemingly available to make purchases beyond the basics, leading to increased lamp sales. However, in recent weeks sales have slowed, perhaps because families had to pay the annual fees for their children to attend school. All in all, through this study we have been learning a great deal about the market potential for LED lighting products in the range of 1000-3500 Ksh. Our past research has shown that these products have the potential to reduce the overall cost of lighting, reduce greenhouse gas emissions, and improve indoor air quality.

In addition to the market trial, we designed and carried out a detailed study focusing on flashlight use to further understand and document the importance of such a basic lighting device and to document the poor quality of flashlight products that are currently available to low-income users. We also measured the air exchange rate in Kenyan off-grid homes to provide HSU professor Dustin Poppendieck with additional information he needed to assess indoor air quality and health risks associated with using kerosene for lighting.

On a return trip this winter, Jenny will conduct follow-up studies with the lamp owners who purchased products from the shop. She will also bring several improved quality low-cost flashlights to get feedback about the products from flashlight end-users with the goal of improving the quality of available flashlights in Kenya.

Project Updates

University Curriculum Project Richard Engel

Since our last update, we have completed fabrication of two dozen benchtop fuel cell/electrolyzer kits and one of two fuel cell test stations to be built as part of the Hydrogen Energy in Engineering Education (H_2E^3) project (see pictures, below). The purpose of the DOE-funded H_2E^3 project is to bring hands-on hydrogen and fuel cell education into classrooms and labs across the University of California and California State University systems. University of California, Berkeley and several fuel cell companies are partnering with SERC on the project.

During this fall semester, we will provide the new lab hardware along with complimentary lesson plans and slide shows to instructors in introductory engineering, thermodynamics, and energy and society courses at Humboldt State University and Berkeley. The fuel cell/electrolyzer kits allow students to generate hydrogen from water and grid or solar electricity, store the gas, and operate a fuel cell to power mechanical loads. Efficiency of every energy conversion step can be measured using provided instrumentation.

The test stations allow automated testing of fuel cell stacks up to 500W output. The stations incorporate many of the features found in SERC's larger, more expensive test stations, yet are portable enough to be moved from lab to lab or even transported between campuses over the course of the H_2E^3 project. Each test station includes an 8-cell, 300cm² fuel cell stack built in-house by SERC.

In addition to developing all of these project materials, we also traveled to Washington, DC in May to give a well-received presentation on the H_2E^3 project at the DOE's annual hydrogen program merit review and evaluation meeting and delivered our first annual project report to DOE.

North Coast Teachers Learn HyTEC Andrea Allen

SERC had a busy summer working to get the Hydrogen Technology and Energy Curriculum (HyTEC) into high school classrooms. HyTEC

is a 2-3 week curriculum developed over the last four years through a partnership between Lawrence Hall of Science at UC Berkeley (LHS) and SERC. HyTEC is designed to introduce high school chemistry and environmental science students to hydrogen energy and fuel cell concepts in the course of their regular classwork.

We led two 2-day teacher training workshops at Humboldt State University (HSU) for local teachers and participated in another 2-day teacher training at LHS in Berkeley for teachers from across the nation.

The local workshops reached a diverse set of teachers. Our first, held the last week of June, included three teachers who teach high school chemistry, physics, environmental science and automotive technology. Our second workshop, held in August, was part of the larger week-long Design Your Future (DYF) Teacher Institute. The DYF Institute's goal is to incorporate engineering into science and math curricula for K-12 students. The 12 middle school and high school DYF teacher participants teach a variety of math and science subjects, including life sciences. These workshops were the first time that HyTEC has been presented to teachers teaching grades lower than high school and subjects other than chemistry and environmental science.

The DYF workshop provided a unique opportunity to create and include an engineering design component in the curriculum. Both workshops gave SERC presenters the opportunity to gauge teacher response for including HyTEC in classrooms where subjects other than chemistry and environmental science are taught. Overall, teacher participants were very positive about HyTEC and are looking forward to incorporating the curriculum into their classes.

Local workshop participants each received a HyTEC electrolyzer/fuel cell experiment set. Teachers will also be able to check out classroom experiment sets from SERC, receive in-class support as needed, and have the option of bringing students to HSU for a tour of our hydrogen fueling station and hydrogen-powered vehicle to see real world applications of hydrogen energy.

SERC is excited about the debut of HyTEC in North Coast classrooms, and we will continue our work with LHS in the coming year to ready the curriculum for a nationwide debut.

HyTEC teacher training participants Pam Halstead, Jack Sheppard, and Rey Urbach (l to r) perform an experiment from the electrolyzer/fuel cell lab portion of the curriculum.



Welcome New Faculty Research Associate

All of us at SERC are pleased to welcome Dr. Eileen Cashman as a new SERC faculty research associate. Eileen is a Professor in the Environmental Resources Engineering department at HSU. She is an alumna of the ERE Department where she received her B.S. degree in 1984. She went on to the University of Wisconsin, Madison where she received an M.S. in Energy Policy and Analysis and a Ph.D. in Civil and Environmental Engineering. After her student work and prior to returning to teach at HSU, Eileen worked for Pacific Gas and Electric Company, Wisconsin Energy Corporation, the US Geological Survey and James Madison University. At SERC, Eileen is currently involved in the feasibility study for hydroelectric resources for the Yurok tribe and the H₂E³ university curriculum project (see the project update section to learn more about these projects). A little known fact is that Eileen teamed with SERC director Peter Lehman to form the double play combination for the engineering softball team in the early 1980s.



SERC Raises Wind Monitoring Tower with the Yurok Tribe



SERC staff and Yurok Tribe members recently raised a 50-meter meteorological tower atop McKinnon Hill on the Yurok Reservation. The tower will be used to collect wind data for one year, and SERC will use the data to conduct a wind energy feasibility analysis for the Tribe. At left, SERC engineers Richard Engel and Chris Carlsen work with Yurok planner Austin Nova to raise the gin pole. At right, the tower raising team celebrates their accomplishment. From left are Roger Gibbons, Richard Engel, Austin Nova, Chris Carlsen, Colin Sheppard, Victor, Jim Zoellick, and Ray Daniels (Six Rivers Communications).

Looking Back

20 years ago...SERC began its mission to promote the use of clean and renewable energy. Who knew that an out-of-the-blue phone call from Mr. Schatz would lead to a thriving research center committed to a clean energy future? Visit us at www.schatzlab.org to learn more about our 20 years of experience with renewable energy.



SERC co-directors Arne Jacobson and Charles Chamberlin and Director Peter Lehman (*l to r*) at the 20th Anniversary picnic, and SERC's celebratory logo-cake, decorated by Alina Taalman.

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. Faculty Research Associates include Eileen Cashman and Steven Hackett. Research and administrative staff include Andrea Allen, James Apple, Matt Bray, Christopher Carlsen, Greg Chapman, Richard Engel, Ray Glover, Meg Harper, Peter Johnstone, Patricia Lai, Marc Marshall, Tirian Mink, Allison Oakland, Joe Purdon, Mark Rocheleau, Scott Rommel, Adam Schumaker, Colin Sheppard, Garren Sparks, Alina Taalman, Jennifer Tracy, and Jim Zoellick.

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