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The quarterly newsletter of the Schatz Energy Research Center
HUMBOLDT STATE UNIVERSITY

Sustainable Energy for the Yurok Nation

Richard Engel

The Yurok Tribe, whose remote homeland stretches from the seashore to the inland mountains of northwest California, are close neighbors of SERC. We have worked with the Yurok on a number of occasions, helping them to power a telecommunications repeater station with a SERC fuel cell and build an off-grid residential solar power system to provide tribal elders with reliable electricity. Communities located on the mountainous Yurok Reservation are among the last few in California that have never been connected to the statewide electric power grid...and are also some of the poorest in the state. This situation results in a population with special energy needs.

SERC recently launched a partnership with the Tribe to develop an ongoing Yurok energy program. The program's goals are to improve energy security and reduce energy costs for Tribe members while providing energy-related job training and employment opportunities to the Tribe. The Yurok Tribal Council is also interested in achieving economic development using natural resources found on their reservation, including biomass, hydroelectric, and solar energy. However, the Tribe have made it clear that any energy development projects must minimize impacts on their land, their waters, and their many sacred cultural sites.

SERC engineer Jim Zoellick explains solar hot water and solar electric technologies to Yurok tribe members participating in an intensive two-week course on energy.

The Tribe has been awarded two grants by the U.S. Department of Energy (DOE) to begin creation of their energy program. SERC is working under contract to the Tribe to help implement both grants. SERC's activities with the Tribe to date include:

- Providing quarterly trainings to tribal staff on practical energy topics.
- Conducting a two-week intensive training course for Tribe members in residential energy efficiency auditing and the design, installation, maintenance, and repair of home renewable energy systems.
- Providing training and ongoing field support to two energy specialists as they conduct house-by-house energy audits on the reservation and perform minor repair and maintenance of solar and microhydroelectric systems.
- Creating a public outreach program to raise community energy awareness through brochures and direct one-on-one outreach.

The funding from DOE will also allow the Tribe to examine the feasibility of creating a tribal energy services utility. The energy audit data being collected will help us identify the unique energy needs on the Reservation. In addition, SERC is working with tribal staff to perform an inventory of the Tribe's energy resources and determine what steps are necessary for the

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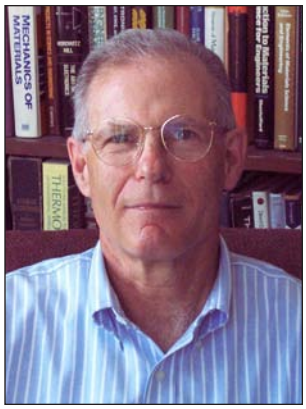
A Message from the Director

Peter Lehman



Once again, I'm proud to be a Californian. As part of a landmark deal reached recently by Gov. Arnold Schwarzenegger and legislative Democrats, California will become the first state to impose a cap on all greenhouse gas emissions, including those from industrial plants. The agreement marks a clear break with the Bush administration and puts California on a path to reducing its emissions of carbon dioxide and other greenhouse gases by an estimated 25 percent by 2020. It will utilize a market program that will allow businesses to buy, sell and trade emission credits with other companies.

Meanwhile, last week during a major address in San Francisco, California's Senator Diane Feinstein, called global warming "the greatest environmental challenge facing this planet." She proposed a package of legislation that would require automakers to boost fuel economy, increase use of renewable energy sources such as wind and solar and force companies to lower emissions of the greenhouse gases. SERC worked with the Senator's staff to help shape the legislation by providing a comprehensive white paper on climate change last December. We're proud to have been part of this effort and we'll do all we can to help the Senator push forward with her important work.

Closer to home, this issue of our newsletter highlights another successful University- National Parks Energy Partnership Program, our sixth so far. This program pairs engineering student interns with Redwood National and State Parks to work on energy efficiency and renewable energy projects. This year's interns, Erin McDonald and Matthew Smith, resurrected and installed a photovoltaic energy system at a ranger residence in the park. A wonderful sight at the lab this summer was seeing Erin and Matthew with their welding aprons on having a great old time welding up their PV support structure.

You can also read updates on our work with the Yurok Tribe to increase energy efficiency and renewable energy on their reservation, our Hydrogen Technology and Energy Curriculum (HyTEC) work with Lawrence Hall of Science, our work training operators and first responders for a hydrogen vehicle program at SUNY Buffalo, and our Fall line-up for our Energy, the Environment, and Society speaker series. I hope you enjoy learning about our progress.

Coming Full Circle at Redwood National and State Parks

Peter Johnstone and Erin McDonald

In the spring of 2000, SERC initiated a collaboration with the University-National Park Energy Partnership Program (UNPEPP). This past summer, the SERC-UNPEPP relationship reached a new milestone with the completion of a renewable energy project six years in the making.

UNPEPP links national parks with university energy programs all over the United States. Students work as summer interns in the parks, identifying opportunities to improve energy efficiency or use renewable energy. Since the collaboration began, SERC and nearby Redwood National and State Parks (RNSP) have successfully completed five renewable energy-related projects, including design and installation of solar electric and solar hot water systems and energy efficiency analyses at various park facilities.

SERC's first UNPEPP project was a site analysis and the design of a renewable energy system to power an off-grid ranger residence located at Espa Lagoon in Prairie Creek Redwoods State Park, a unit of RNSP. UNPEPP interns Lonny Grafman and Angelique Sorensen designed a solar photovoltaic and fuel cell system for the site in the summer of 2000, but the plan was not implemented due to a funding shortfall at the Park.

In 2006 RNSP proposed reviving the project. The Park had finally overcome the funding problem by salvaging solar equipment (used but still in fine condition) from another decommissioned facility. The site analysis performed in 2000 laid the foundation for the 2006 project. 2006 UNPEPP interns Erin McDonald and Matthew Smith, both undergraduate environmental resources engineering students at Humboldt State University, began their internship with a renewable energy training led by SERC engineers. The training provided basic information on a variety of renewable power systems, including system sizing, design and installation.

Intern Matthew Smith welds parts for the PV rack.

The power system being replaced included two antiquated, oversized diesel generators located adjacent to an otherwise beautiful and serene lagoon ecosystem. Overall system efficiency was less than 7%. In addition to their technical shortcomings, the noise, air, and groundwater pollution issues associated with these generators called for a renewable energy replacement more in line with the residence's natural setting. The hybrid system replacing the generators is a solar PV array with a quieter, cleaner, and appropriately sized propane generator as an alternate generation

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UNPEPP *(continued from page 2)*

source. The propane generator will operate in winter or during consecutive cloudy days when the PV system cannot meet the total load. Given the limited solar resource at this often foggy Northern California coastal site, Matthew and Erin estimate that the PV portion of the system will meet 38% of the year-round residential electric load.

Although the design from 2000 recommended the purchase of new equipment, the 2006 project obtained all major components from previous RNSP installations; a successful strategy that offset the need to spend additional money on equipment. After revisiting the UNPEPP 2000 interns' site recommendation, load calculations and solar resource data, and then testing the performance of the old equipment, the interns determined where to place system components for best performance. Working closely with SERC machinist Ray Glover, Erin and Matthew designed and constructed a custom steel rack to hold the PV modules. The interns then transported the rack and equipment to the project site and installed them with the assistance of Park employees.

For the past six years, UNPEPP interns have had rewarding educational experiences while helping our national parks become more sustainable. Interestingly for SERC, what may be our final UNPEPP collaboration turned out to be the completion of our first; the UNPEPP 2006 interns installed a solar electric system based on design recommendations made by the UNPEPP 2000 interns, and the renewable energy system for the Espa Lagoon ranger residence has come full circle.

Interns Erin McDonald and Matthew Smith (*lower right*) pose with RNSP employees after successful installation of Espa Lagoon's new PV system.

"UNPEPP provided an amazing opportunity to apply classroom engineering theory to a real world need and create a more renewable solution."
Erin McDonald

Yurok Energy Program *(continued from page 1)*

Tribe to increase its sustainable use of these resources, for the Tribe's own use and possibly for export to bring needed income to the Tribe.

SERC's relationship with the Yurok Tribe brings new opportunities to the Tribe and allows SERC to deliver on its commitment to increase reliance on clean energy in our north coast region.

Hydrogen Safety and Awareness Training

Jim Zoellick

SERC Director Dr. Peter Lehman and Senior Research Engineer Jim Zoellick recently provided a hydrogen safety and awareness training to staff and safety officials at the State University of New York at Buffalo. SUNY Buffalo just received two hydrogen powered Toyota Prius hybrid vehicles and a portable refueling appliance from Quantum Technologies. The project is funded by the New York State Energy Research and Development Authority.

SERC provided safety and code review services for SUNY Buffalo's proposed refueling installation. SERC also conducted a very successful three-hour safety and awareness training. According to Paul Hoffman, the maintenance department manager at SUNY Buffalo, his crew was very concerned about handling hydrogen vehicles. In fact, they had gone to their union steward and asked whether they could be forced to fuel the vehicles. However, following the SERC training Paul said his crew was very enthusiastic and had no problems fueling and handling the vehicles. One of the points we stress in our trainings is that if hydrogen is handled properly, it is no more dangerous than other transportation fuels we are accustomed to using. We think they got it.

Docent Corner

Allison Oakland

Docents Get HyTEC

Fall has begun and with it a flurry of activity in our education and outreach program. We added four new docents to our program, three Environmental Systems graduate students and one undergraduate in Environmental Resources Engineering. Our program now has eight docents, our largest group thus far.

During their first week, docents received training in our Hydrogen Technology and Education Curriculum (HyTEC) electrolyzer/fuel cell lab equipment and then provided backup support for the HSU Engineering classes that performed the lab. Even though the HyTEC project was developed for high school chemistry students (as described below), the positive feedback received after performing the lab in college courses demonstrates how the lab can be readily incorporated into college level courses.

New docents Lucas Siegfried, Kristen Radecsky, Joe Purdon and James Apple *(left to right)*.

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Fall Speaker Series Lineup

SERC is pleased to host an exciting fall semester lineup for the Energy, Environment, and Society speaker series. This is the second year for the series, and we look forward to building on last year's success. The series is organized in conjunction with the Environment and Community Graduate Program's "Sustainable Futures" speaker series.

Speakers in the fall series include Dr. Anna Zalik of UC Berkeley and York University (October 5), Dr. Evan Mills of Lawrence Berkeley National Laboratory (November 2), and Dr. Sarah Goldthwait of Humboldt State University (November 30). All of the presentations will take place on the respective dates from 5:30 to 7:00 PM in Founders Hall Room 118.

The talks will cover subjects ranging from oil and conflict in Nigeria and Mexico (Dr. Zalik) to the biological implications of climate change in the world's oceans (Dr. Goldthwait). The presentations will also include a discussion of the socio-economic and environmental dimensions of fuel based lighting in developing countries (Dr. Mills).

Video and DVD recordings of many of the lectures in this series are available in the HSU Library's media collection. For more information about the series visit www.schatzlab.org/speaker_series.html.

HyTEC *(continued from page 3)*

The HyTEC project began in 2005 with funding from the Department of Energy. Project partners include lead contractor the Lawrence Hall of Science at UC Berkeley, SERC, and AC Transit Authority. The goal of the project was to develop and test a hydrogen and fuel cell curriculum for high school chemistry students, and to provide a framework for students to discuss the current challenges and potential promise of a hydrogen economy in the context of energy use and resources. SERC's role in the project is development of the electrolyzer/fuel cell lab sets, manufacturing a Stack-in-the-Box® portable fuel cell system, and providing curriculum development support and technical oversight.

To date, we have successfully developed a two-week hydrogen and fuel cell curriculum module, designed and fabricated eight student fuel cell sets, and manufactured a Stack-in-a-Box®. We have completed three high school trials testing the fuel cell and electrolyzer equipment and corresponding curriculum, as well as the HSU Engineering class activities.

HyTEC is a success; in each venue where we have tested the materials, we have received enthusiasm and support from both teachers and students. As we wind up our currently funded work, project partners are seeking additional funding to ensure even more students and teachers get "HyTEC." To stay abreast of our developments visit www.schatzlab.org/hytec.html.

Looking Back

11 years ago...SERC's prototype fuel cell powered golf cart debuted at the annual Electric Vehicle Parade in Palm Desert, CA. Taking turns at the wheel were SERC's benefactor Dr. Louis Schatz and City of Palm Desert Mayor Walt Snyder. The city received a small fleet of fuel cell golf carts as part of the Palm Desert Renewable Hydrogen Transportation Project; two golf carts for use by the parks department and a third for use as a commuter car by the city's economic development manager. Palm Desert was a natural choice for the project as the city is home to more than 20,000 street legal golf carts. For more information visit www.schatzlab.org/transportation.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 and Charles Chamberlin. Research and administrative staff include Dawne Abdul Al-Bari, Andrea Allen, Greg Chapman, Ranjit Deshmukh, Richard Engel, Ray Glover, Arne Jacobson, Peter Johnstone, Marc Marshall, Allison Oakland, Antonio Reis, Mark Rocheleau, Scott Rommel, Michael Winkler, and Jim Zoellick.

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