SERC
ENERGY NEWS

Summer 2010
Volume 5, Number 2

Features

In Every Issue

The quarterly newsletter of the Schatz Energy Research Center

HUMBOLDT STATE UNIVERSITY

Patsari Cookstove Construction at SERC

Ruben Garcia

SERC recently had the pleasure of hosting and collaborating with members of the Interdisciplinary Group for Appropriate Rural Technology (GIRA - www.gira.org.mx), on the construction of a Patsari cookstove. GIRA is a non-profit organization based in Patzcuaro, Mexico and is dedicated to the design, development, and promotion of environmentally and socially sustainable technologies and natural resource use. GIRA is internationally recognized for the design and dissemination of their Patsari cookstove, for which they received an Ashden Award for Sustainable Energy in Health and Welfare in 2006.

Studies estimate that approximately half of the world's population uses biomass for cooking. Wood, charcoal, dung, and other agricultural residues are used as fuel sources for a variety of different cooking techniques. Unfortunately, studies also show that indoor combustion of biomass emits pollutants that cause over 1.6 million deaths per year globally, most of which are women and children. Emissions have also been linked to global warming. New research on black carbon, also known as soot, estimates a 20-year global warming potential between 700 and 2200 times that of carbon dioxide. Since the 1980s, improved cookstove programs have sought to increase efficiency and reduce emissions of stoves. Though stove technology has been improved, there are a host of other factors (economical, educational, and cultural among others), that are crucial to successful stove dissemination and adoption.

Dr. Omar Masera, founder of GIRA, and colleagues Dr. Victor Burrueta and Ph.D. candidate Ilse Mercado Ruiz, lead the Patsari stove building process at SERC. The Patsari stove is based on a simple, location adaptable design that relies on readily available materials such as brick, sand, and clay. Materials vary from region to region and this presented a challenge during the construction process at SERC. For example, commercially available clay in Arcata is refined in a factory. In order to achieve a material similar to that used in small rural communities in Mexico, the stove-building team had to test various mixtures of clay, sand, and cement.

l to r Ilse Ruiz, Dr. Omar Masera, Schatz Fellow Tirian Mink, and Dr. Victor Burrueta in the early stages of cookstove construction.

After a long day's work, the Patsari stove was completed. The following morning the stove

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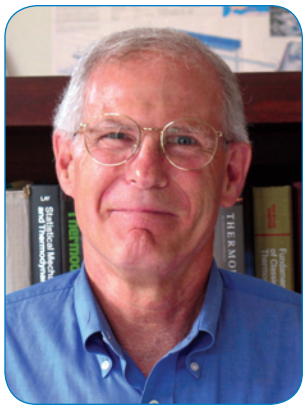
A Message from the Director Peter Lehman



Three months ago in this column, I took the Obama administration to task for announcing that vast tracts of seabed were being opened to oil and gas exploration and exploitation. It turns out that the administration's timing could not have been worse. The oil spill in the Gulf has highlighted in a stark and graphic fashion one of the many ways that our dependence on fossil fuels is dangerous.

The image that keeps going through my mind is kids playing with matches. We've unleashed forces that we don't completely understand and can't control. The marine life, the coasts, the wetlands, and the people who live in that biologically rich area will pay the price for our carelessness for decades to come.

It doesn't have to be this way. As I said last time, we at the Schatz Center firmly believe we can replace a large portion of our fossil fuel use with renewable energy. We will have to pay more for energy but ask the people in the Gulf region how much they're paying right now. Which cost is higher?

In this issue, we highlight some of our efforts to get to that renewable energy future we need. Ruben Garcia reports on our collaboration with colleagues at the Group for Appropriate Rural Technology in Mexico. Omar, Victor, and Ilse visited for a couple of days and helped us build their famous Patsari cookstove here at SERC. We had great fun working together, built a great looking stove, and hope that this will lead to a continuing partnership to improve the efficiency of cookstoves. Also in this issue, Colin Sheppard reports on the beginning of a wave modeling study to support the development of PG&E's WaveConnect™ project. The wave energy resource off the Humboldt County coast is enormous and this work and PG&E's project are a start down the road of tapping that large resource. And James Apple describes the GridShare project that will provide smart grid devices to a village in Bhutan to alleviate the problem of frequent brownouts in their hydroelectric power system. James and his student colleagues won their award at a competition in Washington DC as part of EPA's People, Prosperity, and the Planet program. Congratulations to the students and their mentor, SERC co-director Arne Jacobson. James, Meg Harper, and Chhimi Dorji, HSU grad student and Bhutan native, will travel to Bhutan soon to begin work there.

Best wishes to all our readers for a fun and relaxing summer.

A Smart Grid Solution to Prevent Brownouts in Bhutan James Apple

Students from SERC and the Renewable Energy Student Union (RESU) won a $75,000 EPA grant to implement a Smart Grid device to reduce brownouts on village-scale electrical grids in developing countries. We developed the device, known as GridShare, with support from the EPA's People, Prosperity, and the Planet (P3) program. In April, we demonstrated GridShare technology at the National Sustainable Design Expo in Washington, D.C. and we were among fourteen teams to receive P3 Phase Two funding. During the next year, we will travel to Bhutan to implement GridShare technology in the remote village of Rukubji.

The objective of the project is to reduce brownouts on village-scale electrical grids, many of which are powered renewably with hydroelectric generators. Hydropower produces plenty of electricity during most of the day, but local electrical grids become overburdened during the evening hours when residents cook meals with electric rice cookers and water boilers. The excessive demand causes a brownout, a drop in electrical grid voltage, nearly every evening. Brownouts result in dim lights, slower cooking, and difficulty using sensitive appliances.

The Phase I project team displays the Phase II funding award. *l to r* Kyle Palmer, James Apple, Meg Harper, Chhimi Dorji, Jenny Tracy, Joey Hiller, faculty advisor Dr. Arne Jacobson, James Robinson, and Nathan Chase.

Brownouts could be prevented in several ways. Utility companies could install new power plants or energy storage systems to meet peak electricity demands during evening hours. However, energy generation and storage are too expensive for most rural villages. Power plants also cause environmental damage, especially if they rely on fossil fuels. A more affordable and environmentally-friendly option is to encourage residents to use their appliances earlier in the day, a concept known as "load shifting."

RESU developed GridShare technology to encourage load shifting.

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SERC to Conduct Wave Monitoring & Modeling Research for PG&E WaveConnect Colin Sheppard

Humboldt County is awash with renewable energy resource potential and wave power is the largest by far. Pacific Gas and Electric recognizes this potential and is developing a pilot scale wave power facility called WaveConnect™ off the coast of the Samoa Peninsula, directly west of HSU. Their objective is to install a "power strip under the sea" providing wave power manufacturers an opportunity to deploy and evaluate their wave energy conversion (WEC) devices.

One technical challenge to this project is wave monitoring and forecasting. Buoys capable of measuring the waves will be deployed at the site, but they are expensive and only provide data at a single point. PG&E would like the capability to measure and forecast the waves over an entire domain (in and around the WaveConnect™ project site), in real time, with high resolution, and at low cost.

PG&E has contracted with SERC to take on this challenge over the next year. Through cutting edge integration of modeled wave conditions with real-time measurements, SERC will develop local expertise and software capabilities to generate detailed characterizations of the ocean environment in and around the WaveConnect™ project site.

The project will be based around modeling the wave regime for the entire Humboldt coast using a modeling framework such as Delft University of Technology's SWAN model (Simulative WAves Nearshore). The model predictions will then be enhanced through analysis and integration of real-time data from wave buoys, X-band radar systems, and video monitoring systems.

The ultimate goals of this work include:

- Assessing the overall resource at the WaveConnect™ project site by running the wave model with historical inputs such as buoy data.
- Assessing the impact of the project on the coastal environment.
- Enabling PG&E to conduct comprehensive and fair evaluations of the performance of the WEC devices.
- Providing reliable estimates of current and future wave conditions to assist critical operational and maintenance decisions.

SERC is excited to be involved in the development of a new technology that has the potential to be a major part of a sustainable energy future.

Project Updates

New SERC Building

The new SERC lab and office building is nearing completion and looking really good. The exterior stucco has been applied and the classy cedar wood trim is going up. The windows are all in as are most of the doors. Sheetrocking has started in the main office area and the roof goes on next week. It's getting easier and easier to imagine what the finished building will look like.

That said, the construction has been delayed by the rainiest spring in Humboldt County history and some procurement delays. That means we'll probably not be moving in until late September or October. And we've postponed our grand opening from this October to sometime next spring. We'll let you know as soon as the opening is rescheduled.

Patsari Cookstove Construction continued

was put to the test by successfully cooking a fresh batch of quesadillas (see photo, below). The construction process marks the beginning of collaboration between GIRA and SERC. The goal is to use the stove as a tool to develop research projects aimed at investigating the relationship between stove combustion design parameters and black carbon emissions. We'll keep you apprised of this collaborative effort in future newsletters.

A GridShare will be installed along with the circuit breaker box on the side of every house, and indicator lights will be installed inside each house. GridShares encourage load shifting in two ways: by indicating the state of the grid and by preventing residents from using large appliances during brownouts. When voltage on the grid is sufficient, an LED indicator shows a green light, and any appliance may be used. During a brownout, the indicator shows a red light, and power consumption is limited to 400 watts (sufficient for small appliances but too low for rice cookers or water boilers). Over time, residents will learn about their grid by watching the indicator lights, and the automatic power-limiting mode will encourage residents to use their appliances during non-brownout times.

This July, Chhimi Dorji, Meg Harper, and I will travel to Bhutan to survey residents and install the first GridShare prototypes in Rukubji, with the support of the Bhutan Power Corporation and the Department of Energy of Bhutan. We hope to learn more about the village electrical grid and gain input from residents regarding our approach to brownout reduction. In December, a second SERC/RESU team will visit Rukubji to install GridShares throughout the village. If the installation is successful, Rukubji may be the first of many villages to see the benefits of a more stable electrical grid.

Residents of Rukubji meet with representatives from HSU, the Department of Energy of Bhutan, and the Bhutan Power Corporation to discuss methods of reducing brownouts.

Looking Back

3 years ago...SERC worked under contract to Alliance to Save Energy (www.ase.org) to develop the Student Energy Auditor Training (SEAT) program, a hands-on curriculum for teaching students about energy by performing a real efficiency audit of their own school. SERC developed three-day and one-day versions of the course for high schools and a one-day middle school course. SERC staff traveled to several schools across northern California to pilot test the curriculum, finding many students responded enthusiastically to the SEAT program. The program is now in use in schools across the U.S.

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 are Eileen Cashman and Steven Hackett. Research and administrative staff include Andrea Alstone, Peter Alstone, James Apple, Nir Berezovsky, Christopher Carlsen, Greg Chapman, Richard Engel, Ruben Garcia, Meg Harper, Kevin Jensen, Patricia Lai, Marc Marshall, Tirian Mink, Allison Oakland, Tom Quetchenbach, Mark Rocheleau, Scott Rommel, Lucas Scheidler, Charlie Sharpsteen, Colin Sheppard, Alina Taalman, and Jim Zoellick.

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