SERC
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Features

In Every Issue

The quarterly newsletter of the Schatz Energy Research Center

HUMBOLDT STATE UNIVERSITY

SERC's Off-grid Solar Testing Laboratory Gains International Recognition

Ga Rick Lee

SERC recently became accredited under ISO/IEC 17025, the single most important standard for testing laboratories around the world. This accreditation recognizes SERC's technical competence to perform laboratory testing and produce precise and accurate test results. Specifically, SERC is accredited to carry out electrical and photometric testing of off-grid solar lighting products. This accreditation may be expanded in the future to include off-grid solar home systems and other technologies.

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

SERC leads the World Bank Group's Lighting Global Quality Assurance program for off-grid solar lighting products, and tests dozens of these products each year. This new accreditation enables our test results for quality-assured, off-grid solar lighting products to be recognized by governments around the world, easing the importation of these products into countries that greatly need them. This in turn will increase access to these products for the many people in developing countries who currently rely on dangerous, unhealthy, expensive and dim kerosene lighting.

To become accredited under ISO/IEC 17025, we undertook a six-month process to formalize and update our laboratory quality management system. This included putting comprehensive policies and procedures and rigorous quality control practices in place, and training staff to follow these. All of our relevant equipment was also sent for calibration to ISO/IEC 17025 accredited laboratories to ensure that we produce the most precise and accurate results possible.

SERC was then assessed by ANAB, our ISO/IEC 17025 accreditation body. For two days in December, a visiting assessor audited our policies and procedures and witnessed testing conducted by SERC staff. After the visit, the assessor provided us with a list of non-conformities to the ISO/IEC 17025 standard, which we quickly addressed. As a result, our accreditation certificate was issued on January 8, adding SERC to the ranks of internationally recognized test laboratories.

A Message from the Director

We are pleased to welcome two new faculty members to SERC and the Environmental Resources Engineering (ERE) Department. We recently received confirmation that Peter Alstone and Liza Boyle accepted the tenure track positions that were offered to them. They will bring new ideas and dynamism to the ERE Department and SERC, and we are excited to have them join us.

Peter completed a PhD in the Energy and Resources Group at UC Berkeley this past fall, and is currently a post-doc at Lawrence Berkeley National Laboratory. He is an alumnus of SERC and has an MS from HSU (ERE option of the Environmental Systems graduate program). His bachelor's degree is in chemical engineering from North Carolina State University. Peter's dissertation examined the role that information technology is playing in enabling the expanded use of clean energy, and his dissertation revolved around a case study of the off-grid solar market in Kenya. His postdoc work at LBNL involves analysis to estimate the potential for demand response on California's electrical grid. The work is being used by the California Public Utilities Commission to set state policy related to demand response and grid integration of renewable energy. Peter's position at HSU is a joint appointment, with responsibilities at SERC (40% of his time) and the ERE Department (60%).

Liza also finished her doctorate in the fall of 2015. She graduated from the University of Colorado, Boulder with a PhD in Mechanical Engineering. She has MS and BS degrees in mechanical engineering from CU Boulder and the University of the Pacific, respectively. Liza's dissertation focused on the effect of soiling due to particulate deposition on the performance of solar photovoltaic arrays. The work involved experimental measurements and statistical analysis aimed at identifying factors that affect array performance. In conducting the research, Liza drew from her expertise in solar energy and air quality. The work is intended to lay the foundation for the development of tools to help commercial solar operators optimize power production and operations costs for their arrays. Liza's faculty position in the ERE department puts her in a good position to engage in research through SERC, and we look forward to collaborating with her when she joins us here at HSU.

In other SERC news, we are happy to welcome Kim Thorpe as a new staff member. She is working on our energy access projects. We have also remained very busy with project work, and are engaging closely with the HSU planning department and an architectural firm as they work to design a 1900 square foot addition for SERC.

Goodbye until next time.

"The Energy Ladder Research" Launches in Uganda

Richa Goyal

SERC has received a research grant from UNCDF's CleanStart Programme to conduct a yearlong study in Uganda. This study aims to explore

- solar energy product adoption patterns for off-grid rural users and if flexible consumer financing methods can help enable adoption of higher levels of access
- if the use of off-grid solar products leads to improved communication by supporting the use of mobile phones and other similar devices
- if, given the rise of mobile banking and pay-as-you-go sales models in the off-grid solar sector in East Africa, these solar products have the potential to increase access to mobile banking and similar digital financial services.

The adoption process of energy solutions by rural off-grid populations from basic lighting products to more sophisticated off-grid power systems is often explained by using the concept of an 'energy ladder'. A ladder suggests a linear process of adoption involving substitution of inferior technologies with superior ones as users move up the rungs of the ladder. However, it is likely that while substitution does occur in some cases, energy adoption frequently involves fuel and technology "stacking", in which new technologies are obtained but the original technologies are also retained.

In Sub-Saharan Africa, only 14 percent of people have access to grid electricity; however, nearly 70 percent now have access to mobile phones. While the demand for use of mobile phones is high in these regions, they often lack access to electricity and end up paying steep fees for phone charging services in the local market. A symbiotic relationship exists between increasing access to electricity in Africa and expanded use of information, communication and banking services using a mobile phone.

Our research team, which is led by Arne Jacobson, Richa Goyal, and Meg Harper, will take a rigorous look at these assumptions. We plan to initiate activities in March with a preliminary field visit to Uganda. The research initiative is jointly managed by UNCDF's CleanStart Programme and Kat Harrison, Associate Director of Impact at Acumen, and is supported by the Global Off-Grid Lighting Association, GSMA and the World Bank Group.

To access the UNCDF press release, click here.

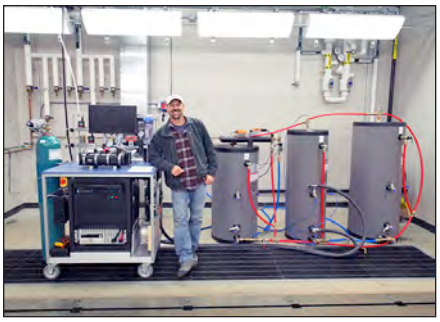
SERC Delivers Fuel Cell Test Station to Purdue University

Greg Chapman

In early December, Marc Marshall and I travelled to Purdue University in West Lafayette, Indiana to install and train staff in the use of SERC's first combined heat and power (CHP) fuel cell test station. CHP is also known as cogeneration. As reported in our Summer 2015 newsletter, the station was custom built for Professor Neera Jain in Purdue's School of Mechanical Engineering.

The test station was designed so that Neera and her engineering students can study the electrical and thermal characteristics of this fuel cell cogeneration system in a simulated residential application. A Ballard fuel cell stack produces the electrical power while waste heat from the stack is transferred to a domestic hot water tank via the fuel cell cooling water system. Custom software allows the researchers to simulate the electrical and domestic hot water use typical of a single-family home. By measuring performance in various conditions, Neera and her students will be able to develop control algorithms to optimize system efficiency.

Household fuel cell cogeneration systems have been field tested over the last few years and are making their way into the market, mainly in Japan and Germany. Panasonic launched its fourth generation fuel cell CHP model in 2015 and has installed over 10,000 units in Japan. Callux continues field-testing in Germany, and is targeting over 500 installed units by mid-2016. Both the Panasonic and Callux cogeneration systems convert natural gas to hydrogen in a reformer before supplying the fuel cell. It will be interesting to follow the progress of these high efficiency and reliable home energy systems as they enter the market.



Top, left to right: Greg Chapman, Professor Neera Jain, graduate students Austin Nash and Rian Browne, and Marc Marshall pose with the newly installed test station. Bottom: Greg Chapman, project manager for the CHP fuel cell test station, poses with the newly installed test station.

Project Updates

North Coast EV Charging Infrastructure

Jerome Carman

The first phase of the installation of electric vehicle charging stations (EVCSs) for the Redwood Coast Electric Vehicle Charging Network (REVNet) is nearly complete. REVNet is a coordinated effort led by the Redwood Coast Energy Authority (RCEA) to jumpstart public charging infrastructure on the North Coast. Over the last year, 10 EVCSs have been installed at nine locations across Humboldt County: Trinidad, McKinleyville, Arcata, Eureka (two stations), Willow Creek, Ferndale, Fortuna, and Rio Dell.

In 2012, SERC partnered with the RCEA in the development of a Readiness Plan for the North Coast region of California. One of the key results of this work was the projected number of publically accessible EVCSs needed to support an on-road fleet comprised of 2% electric vehicles (approximately 3,000 vehicles). In 2013, SERC again partnered with RCEA in the pursuit of funding for the first installation phase of charging stations in Humboldt County, which was successfully awarded under CEC grant ARV-13-029.

This project involves many partners, with SERC coordinating the installation effort as Owner's Engineer for RCEA. Dave Carter is managing construction, with Kristen Radecsky and Jerome Carman supporting. RCEA and SERC partnered with OurEvolution Energy & Engineering to lead the civil engineering tasks, and GHD to review electrical plans. McKeever Energy & Electric Inc., who partnered with DCI Builders for civil contracting work, won the public bid for an electrical contractor to install EVCSs at seven of the nine sites. The other two sites, McKinleyville Shopping Center (owned by Pierson Company) and St. Joseph Hospital, used their own electrical contractors, Ambrosini and Sons and Colburn Electric respectively.

RCEA is piloting a non-profit ownership model. The stations are planned to be operational in March.

A dual head 7.2kW charging station installed at The Greenway Building in Arcata.

Project Updates *(continued from page 3)*

Blue Lake Rancheria Microgrid Dave Carter

Since September, SERC's microgrid team has been engaged in intensive design work with partners Blue Lake Rancheria (BLR), Pacific Gas & Electric (PG&E), Siemens, Tesla, REC Solar, GHD, Idaho National Labs (INL), Robert Colburn Electric, and Kernen Construction. Commissioning of the microgrid is scheduled for October 2016, and we are keenly aware of how much work there is still to do.

Meeting the commissioning schedule requires strategic planning, hard work, and close coordination. Our implementation methodology involves an integrated design approach, with engineers and contractors collaborating on development construction plans as well as equipment and operational specifications. Design reviews and cost checks are programmed into the schedule at the 50% and 90% levels to build and maintain consensus among stakeholders and to determine if value engineering is required as we work towards construction-ready plans. One critical path is obtaining the necessary approvals from PG&E; we have worked to expedite aspects of that process that are under our control.

We accomplished several important milestones in January. The 50% design review and cost check were conducted, and the results indicate that no major course corrections are needed. Our Early Start design package was released for construction on schedule. We also submitted our interconnection application to PG&E.

Looking ahead, we are scheduled to release the design for construction in June, which is also when Siemens is scheduled to complete Factory Acceptance Testing on the microgrid controller. INL will then conduct hardware-in-the-loop testing of the controller in their real-time digital simulator prior to installing it at BLR in September. Meanwhile, construction will be ramping up as the weather dries out this spring.

BRDI Waste to Wisdom: Results from Preliminary Biomass Briquetting Mark Severy

The Biomass Research and Development Initiative (BRDI) Waste to Wisdom project is studying various pathways to increase the value of forest residuals and decrease transportation costs to bring this underutilized resource into the renewable energy market. Densifying waste biomass into briquettes during forest operations may achieve both of these goals by converting it into a valuable heating fuel that is easily transported due to its high density and low moisture content.

Last April, SERC engineers, alongside partners from Pellet Fuels Institute and RUF Briquetting Systems, operated a commercial briquetter with a variety of feedstocks at Bear Mountain Forest Products' manufacturing plant in Cascade Locks, Oregon. Electricity consumption and biomass throughput data were collected in the field, while a pallet containing feedstock and briquette samples was shipped to SERC for material analysis. Back at SERC's lab, the samples were sent through a suite of tests to assess the quality of each briquette and determine which feedstock properties influence the end product's characteristics, such as density, durability, grindability, and moisture absorption.

Results show that this briquetting system increases the volumetric energy density of chipped biomass by nearly 250%, producing briquettes with an average packing density of 720 kg/m3. Feedstocks with moisture content exceeding 15% produce lower density briquettes, which expand in height after exiting the briquette press. High moisture content, however, does not significantly impact briquette durability. Instead, the feedstock's particle size distribution has the greatest effect on briquette durability. Feedstocks comprising mainly large particles, especially chipped biomass, do not bind together as well as fine or ground particles. To improve durability, chipped biomass can be combined with sawdust, which increases briquette durability two-fold and results in briquettes with a binding strength similar to those produced from pure sawdust.

These results help frame and guide our future work with biomass densification. In the next stages of this project, the multidisciplinary BRDI research team will investigate whether the upstream energy investments in drying and particle size reduction are worth the payback when bringing briquettes to the heating market.

Left: SERC Project Manager Dave Carter operates the briquetter. Right: Briquettes produced from chipped biomass exit the briquetting machine.

SERC's mission is to promote the use of clean and renewable energy.

SERC is a member of the California Hydrogen Business Council, the International Association for Hydrogen Energy, the International Solar Energy Society, and the American Solar Energy Society.

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