



SERC

ENERGY NEWS

Forest Biomass Energy: Looking for the Big Picture *Richard Engel*

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The quarterly newsletter of the
Schatz Energy Research Center

HUMBOLDT
STATE UNIVERSITY

This spring SERC embarked on a major forest biomass energy research project in partnership with Humboldt State University's forestry department and researchers, entrepreneurs, and natural resource management agencies from a number of western and midwestern states. The "Waste to Wisdom" project will examine the entire supply chain of biomass, including collection, transportation, and pre-treatment of the material in the woods, as well as conversion of the material into energy and other marketable products using a variety of emerging technologies. Experts in economics, life cycle analysis, and environmental impacts will assess and compare the different biomass pathways.

The project officially launched with a kick-off meeting at HSU on May 13 and 14. The project's thirteen principal investigators as well as several other stakeholders gathered to meet one another and discuss how to coordinate the many components of this complex effort. The meeting included a trip to a nearby timber harvest site on Green Diamond Resource Company land where state-of-the-art technology and logistics are being used to gather, chip, and haul slash for use in Humboldt County's biomass power plants.

SERC's role in the project is to oversee the testing and evaluation of three different types of biomass conversion technologies (BCTs): a biochar unit, a torrefier, and a briquetter. Biochar is solid, carbon-rich biomass that has been treated at high temperature, above 500°C, and is used principally as a soil amendment. Torrefaction takes place at a lower temperature, near 300°C, producing a solid fuel that can be directly substituted for coal in existing power plants. Briquettes are made near ambient temperature by compressing finely ground biomass and can be used in place of cordwood in biomass-fired heating and power generation systems. An important goal of Waste to Wisdom is to adapt each of these BCTs for mobile, stand-alone use



Top to Bottom: Mike Alcorn, chief forester for Green Diamond Resource Company, shows the BRDI research team a site where material is collected for use at Humboldt County's biomass power plants. SERC director Arne Jacobson, U.S. Forest Service economist Ted Bilek, and HSU forestry professor Han-Sup Han will lead BRDI's three research teams.



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A Message from the Director

Happy summer from sunny northern California. I am pleased to let you all know that SERC and the Environmental Resources Engineering (ERE) department at Humboldt State University (HSU) are jointly conducting a search for a new tenure track faculty position. The person hired for the job will divide her or his time between teaching in the ERE department and conducting research at SERC. This is a fantastic opportunity for the right person, and we look forward to bringing a new, dynamic faculty member on board. See the announcement in this newsletter for additional vacancy details.



Speaking of new team members, we are pleased to welcome four new people to SERC. Our most recent addition is Ga Rick Lee, a senior energy analyst from Australia. Ga Rick will work on our energy access projects, including especially our projects related to quality assurance for off-grid lighting and energy systems for rural electrification in Asia and Africa. Much of our work in this area is linked to the World Bank Group's Lighting Global, Lighting Africa, and Lighting Asia initiatives. Ga Rick worked most recently for the Australian Red Cross in the Philippines, and he brings considerable experience and expertise to our already strong energy access team. In addition, we have hired two HSU engineering students, Greg Pfothauer and Janoah Osborne, to work as research assistants on our energy access projects. Their efforts are focused on testing off-grid lighting products and other associated laboratory tasks. We are also very pleased to welcome Manan Parikh to SERC. Manan is working as a research assistant on work focused on assessment of the potential to expand the use of alternative transportation fuels in five northern California counties. These four new team members are in addition to David Carter, who, as I mentioned in our spring newsletter, joined SERC as a senior research engineer in May. We are very pleased to have all of these new people, and their expertise and enthusiasm, on board.

I will close by thanking everyone who was able to join us in celebrating our 25th Anniversary in May. We had a great celebration, and it was good to see many familiar faces and long time friends at the event. A special thanks goes also to the team from SERC who led the effort to organize the event. I appreciate all the good work that went into the preparations.

Goodbye to you all until next time.

SERC Display Illuminates Efficient Solar Home Power Systems Mark Rocheleau

SERC's Lighting Lab recently finished testing efficient DC lighting products for use with off-grid solar home systems, as part of a competition administered by the Global Lighting and Energy Access Partnership (Global LEAP) Awards program. To highlight the awards program, SERC incorporated some of the winning products into a tabletop display illustrating the difference between a solar-powered system with inefficient lighting and one that uses state-of-the-art LED lighting and super-efficient appliances. The display was then presented at the Fifth Clean Energy Ministerial (CEM5) conference in Seoul, South Korea, on May 12 and 13, where ministers, energy officials, and observers from more than 21 countries and the European Union were in attendance. This year's slogan was "Act Together, Think Creative."

Each system includes a 40 watt (W) solar panel, a charge controller, and a 70Ahr battery. In the "inefficient" system, these power a single 25 W incandescent bulb for five hours a day. In the "super-efficient" system, the same solar panel and battery can power two LED lights, each brighter than the 25 W incandescent, for five hours a day; one radio for five hours a day; one 13 W super-efficient flat panel television for over three hours a day; one 6 W super-efficient fan for four hours a day; and one cell phone charger.

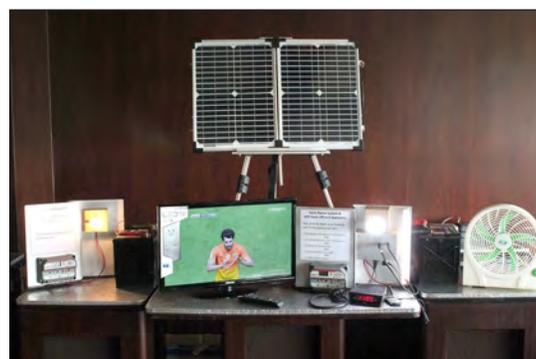
Clearly, the use of high efficiency appliances can greatly enrich people's lives.

This project was a collaboration between the US Department of Energy (US DOE), the Collaborative Labeling and Appliance Standard Program (CLASP), Lawrence Berkeley National Laboratory (LBNL) and SERC. Our team at SERC designed and built the portable display, while Carolyn McGregor of the US DOE, Matt Jordan of CLASP and Won Young Park of LBNL attended the CEM5 conference and manned the booth.

Visit the links below for more information:

- www.globalleapawards.org/en/About-Global-LEAP-Awards.aspx
- www.cleanenergyministerial.org/Events/CEM5
- www.iisd.ca/energy/cem/2014/
- www.clasponline.org

Efficient solar home power system tabletop display.
Photograph courtesy of IISD/Earth Negotiations Bulletin.



Faculty Research Position

SERC and the Environmental Resources Engineering (ERE) department at HSU are searching for a new faculty member. The position will be split between teaching and associated duties in the ERE Department and research activities with SERC. The primary professional responsibilities of instructional/research faculty are teaching, research and scholarship, and service to the University, profession, and community. These responsibilities include advising students, participating in campus and system-wide committees, maintaining office hours, working collaboratively and productively with colleagues, and participating in traditional academic functions.

Successful candidates will demonstrate

- expertise in renewable energy systems and research experience to allow her or him to work productively with colleagues at SERC
- commitment and/or experience promoting and fostering a learning environment that is supportive of individuals from diverse backgrounds
- record of, or potential for, involving students in research and scholarly activity
- potential for effective teaching and teaching experience using a variety of methodologies
- ability and interest in teaching a broad range of engineering courses

This position is open until filled. First consideration will be given to completed applications received no later than October 31, 2014. For complete details, visit the list of vacancy announcements at www.humboldt.edu/aps/employment/tenure.html (select job #7618).

Project Updates

RePower Humboldt: BLR Biomass to Energy Project Jim Zoellick

The design and procurement phases of the BLR Biomass to Energy Project are in full swing and the project team is involved in a flurry of activity. A group of engineers from SERC, as well as staff from Serraga Energy, LLC at the Blue Lake Rancheria (BLR) project site, are meeting weekly to discuss design decisions and move the effort forward. Frequent interactions are also taking place with our technology partners: Proton Power (gasifier), Xebec Adsorption (PSA gas cleanup unit), and Ballard Power Systems (fuel cell). Below is a list of key activities currently underway:

- site layout is largely completed
- fire marshal review - first phase is complete
- site work has begun and will ramp up significantly over the next few weeks
- gasifier is being fabricated - witness testing will occur in late July with delivery in August
- PSA design and fabrication are underway – delivery is expected in late August
- syngas compressor requirements have been specified and quotes have been obtained – orders will be placed in the

next couple of weeks

- fuel cell is on site - installation is slated for July or August
- central control and monitoring system - design is underway
- ventilation system - design analysis is underway
- fuel storage and processing – design is underway
- electrical service (auxiliary power supply and fuel cell generator/utility interconnection) – electrical engineer and contractor team are working on design, procurement, and the utility interconnect application with Pacific Gas & Electric

The next phases of the project will include component installation (summer and early fall 2014), system integration and commissioning (fall 2014), and system operation, data collection, analysis and reporting (late fall and winter 2014/15). Stay tuned for additional updates in upcoming newsletters.

Neil Harris (far right) with electrical and construction experts implementing site design at Blue Lake Rancheria.
Photo credit Serraga Energy, LLC.



Aqueous Phase Reformation Mark Severy

Researchers at SERC are studying alternative pathways for biomass energy to displace fossil fuels in existing high-efficiency power plants. Chemical reactions can harness waste heat to convert biomass into a hydrogen-rich syngas, displacing fossil fuel consumption. Modeling work at SERC estimates that integrated systems can produce between 5% and 100% of a power plant's fuel requirement from biomass, depending on the quality of the waste heat resource. If applied to internal combustion engine power plants, blending hydrogen-rich syngas with natural gas additionally reduces untreated nitrogen oxide (NOx) emissions by up to 95% and increases engine efficiency by up to 25%.

Over the past year, SERC's Dr. David Vernon led a research team to study aqueous phase reformation (APR) of plant-derived sugars to produce a hydrogen-rich syngas. This project, funded by the California Energy Commission, investigated the potential to use this low temperature reformation process to recover waste heat from natural gas power plants. SERC engineers designed, built, and tested a benchtop chemical reactor to convert aqueous sorbitol (C₆H₁₄O₆) into an energy-rich gas consisting of hydrogen, carbon dioxide, and methane. Sorbitol, a sugar alcohol, was

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Project Updates (continued from page 3)

selected as the feedstock because it is easily produced from glucose, a biomass derivative, and reforming sorbitol produces hydrogen at a faster rate than reforming glucose.

Testing was completed in April. Our results showed that APR is able to convert up to 94% of the input sorbitol into a hydrogen-rich gaseous fuel. By synthesizing our own catalysts at SERC, we were able to produce a gas containing 64% hydrogen by volume. Furthermore, the output liquid and gas were found to contain 46% more chemical energy than the input feedstock.

Based on these promising results, we conclude that it is feasible to use APR in waste heat recovery applications. We have applied for additional funding to continue this work. Next, we plan to use crude glycerol, a byproduct of biodiesel production, as the feedstock. Our economic models predict that converting crude glycerol will significantly reduce the lifecycle costs of the system, making this process more cost competitive than other waste heat recovery technologies such as organic Rankine cycles.



Top to bottom

SERC had a busy last month of spring: we celebrated our 25th Anniversary, we presented renewable energy activities at a number of local schools, and we hosted the kickoff of MINDDRIVE's "Raise Your Hand" tour. MINDDRIVE is an after school program for at-risk teens from the urban core of Kansas City, Missouri (photo courtesy of MINDDRIVE).



Forest Biomass Energy (continued from page 1)

at remote sites where utility service is not available. Decentralized deployment of these BCTs could be an economically viable alternative to the costly collection and transportation of raw biomass from far-flung timber harvest and woodland fuel reduction sites.

The \$7.45 million, three-year project is sponsored by the U.S. Department of Energy through the Biomass Research and Development Initiative (BRDI) program, jointly supported by the U.S. Department of Agriculture. Each of the collaborating partners is making a cost share contribution to the project's total budget. SERC's share of the federal funding is \$900,000, to which the lab is adding \$185,000 worth of labor, equipment, and facility use.

SERC director Arne Jacobson will act as principal investigator for the BCT evaluation component of Waste to Wisdom. "We are excited to be involved in this project. We have a great set of partners, and we look forward to a successful effort."

SERC mourns the passing in April of Peter Hoffmann, editor and publisher of the Hydrogen and Fuel Cell Letter. Born in Berlin, Germany in 1935, he came to the U.S. in 1952 and earned degrees from University of South Dakota, Yale University, and Columbia University. He worked as a journalist for the Associated Press, *Time Magazine*, and the *Washington Post*, and was a bureau chief in Europe for McGraw Hill World News. He founded his respected hydrogen industry newsletter in 1986. He also authored two books, *Tomorrow's Energy: Hydrogen, Fuel Cells, and the Prospects for a Cleaner Planet* and *The Forever Fuel: The Story of Hydrogen*.

Peter was a good friend and valued colleague to several of us at SERC. We will miss his unfailing advocacy for a cleaner planet, his continuous good cheer, and his wonderful self-deprecating humor.

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.

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.

SERC advisory board members are Rick Duke, Shannon Graham, Dan Kammen, David Katz, Jaimie Levin, David Rubin, Jeff Serfass, and Andrea Tuttle.

SERC co-directors are Arne Jacobson, Peter Lehman, and Charles Chamberlin. Faculty research associates are Andrea Achilli, Kevin Fingerman, and David Vernon. Research and administrative staff include Nick Bryant, David Carter, Greg Chapman, Meg Harper, Andy Harris, Ian Hunter, John Hunter, Amit Khare, Patricia Lai, Ga Rick Lee, Marc Marshall, Allison Oakland, Carolyn Ortenburger, Janoah Osborne, Manan Parikh, Greg Pfothenauer, Tom Quetchenbach, Kristen Radecsky, Mark Rocheleau, Mark Severy, Colin Sheppard and Jim Zoellick. SERC docents are Onomewerike "Robo" Okumo, Billy Karis, and Yaad Rana.

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