



SERC

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The quarterly newsletter of the
Schatz Energy Research Center

HUMBOLDT
STATE UNIVERSITY

SERC Hosts Biomass Meeting Richard Engel

SERC's recently launched collaboration with biomass energy startup Renewable Fuel Technologies (RFT) reached an important milestone on April 7, when a group of U.S. Forest Service officials, professional foresters, and biomass specialists from across the country convened at SERC for a Torrefaction Research, Development, and Commercialization Meeting.

The meeting included a demonstration of RFT's prototype wood torrefier that had been recently moved to SERC. Many of the meeting participants, including RFT's technical and business leadership team, braved late-season storms and a major landslide to make the trek up from the Bay Area.

The meeting took place just days after SERC and RFT engineers first got the newly arrived torrefier up and running in the courtyard at the new SERC building. A torrefier is a device that heats and dries woody biomass in an oxygen-free reactor. The solid end product has a higher energy density than the feedstock biomass and can be co-fired with coal in conventional power plants, thus directly replacing fossil fuel with a renewable energy source. The torrefier also captures the energy-rich gases given off by the biomass during torrefaction. These torrgases can be used to produce all the heat and electric power needed to drive the torrefier, thus making it a stand-alone device and able to process wood in remote forest locations where no utility power is available.

Under an agreement with RFT, SERC engineers will work in the coming months to perform a complete torrefaction energy and mass balance and characterize the torrefier's performance under a range of operating variables, including reactor temperature, feedstock moisture content, feedstock tree species, and dwell time of biomass in the reactor. The prototype unit produces five pounds per hour of torrefied wood. Using outcomes from SERC's testing, RFT plans to build a much larger, pre-commercial torrefier with an output capacity of 25 tons per day.

SERC's interest in torrefaction grows out of the long-recognized need in western states for a technology to recover biomass fuel from forests economically. Such a device would help to reduce wildfire risk and improve air quality by providing an alternative to the current

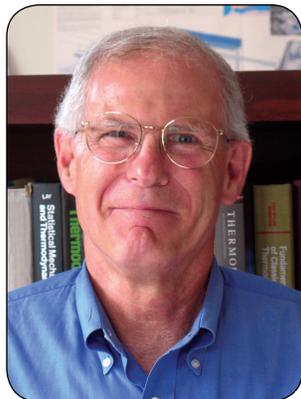


Biomass energy VIPs gather around the torrefier at SERC. *Photo credit Kellie Brown, HSU Photographer.*

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A Message from the Director Peter Lehman

This is the first director's column written in my new office in our new Schatz lab. It's just wonderful to be in this modern, well-designed building that will certainly increase our productivity and has already made us proud. You can read about some of the details and see a picture in the building update in this issue.



But while the Schatz Center has been upgraded, the U.S. hydrogen and fuel cell technology program has fallen from sight. Energy Secretary Steven Chu has suggested that the hydrogen program be zeroed out in the next DOE budget. There is plenty of funding for battery research and plug-in hybrids, but not a penny for fuel cell vehicles. Secretary Chu tried to do this in last year's budget cycle but was rebuffed by a strong coalition of legislators who insisted that the funding be restored.

Picking battery and hybrid cars as a technology winner seems like a big mistake in light of the fact that fuel cell vehicles have come a long way (our Toyota Highlander fuel cell car is a dream to drive) and other places (like Japan, Korea, and the EU) are going gangbusters for fuel cell transportation. How this will play out is anyone's guess but because hydrogen and fuel cells were an emphasis for the last administration, it's hard to believe that Chu's decision is not politically motivated.

In this issue, Richard Engel reports on the biomass meeting we hosted last week. People came from across the country to discuss torrefaction and the research program we are starting. It was our first conference in our new facility. Mark Rocheleau reports on the successful completion of our second Stack-Outside-the-Box™ and its delivery to Southwestern Community College. And in our update section, Jim Zoellick reports on our ongoing RESCO project and Allison Oakland describes how proud we are of the publication of the hydrogen and fuel cell curriculum we developed with Lawrence Hall of Science.

Our Spring has been wet and wild here on the North Coast. We join everyone in anticipating the warmer, sunnier days ahead.

Stack-Outside-the-Box™ Arrives at Southwestern Community College

Mark Rocheleau

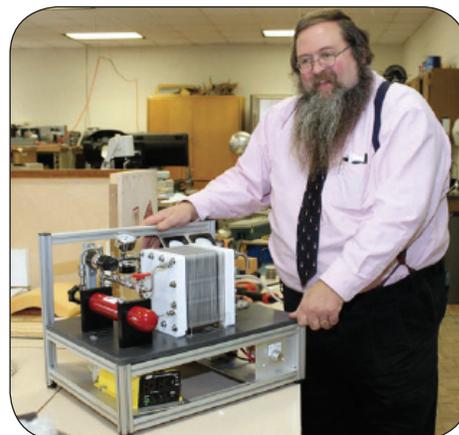
On March 10th of this year, the second Stack-Outside-the-Box™ (SOTB™) that SERC has produced was delivered to Southwestern Community College in Sylva, North Carolina. Receiving the unit was Ron Poor, head of the Electronics Engineering Technology program. Last year, seeking to include the concepts of hydrogen based renewable energy in the curriculum, Ron secured a grant from the Appalachian Regional Commission for the purchase of this bench-top fuel cell power system. "We've never seen Ron so excited," the electronics and computer technology students said when the SOTB™ arrived; they were quoted in the hometown Sylva Herald newspaper.

Designed to provide hands-on experience in educational and laboratory settings, the SOTB™ utilizes SERC's patented low air pressure, PEM fuel cell design. This hydrogen-fueled system produces 12V DC electricity, which, when converted to 110VAC by a small inverter, can generate a continuous output of 75 watts, with a peak output of 125 watts. The pollution-free AC power can then be used to operate standard appliances.

Because the SOTB™ includes an eight-channel data acquisition (DAQ) system with a computer software interface, Ron also intends to incorporate it into the Computer Engineering Technology curriculum. The DAQ system will enable operators to record a variety of run-time data such as voltage, current, and stack temperature, while varying the operating conditions. These data can then be used, amongst other things, to calculate fuel cell efficiency or to compare the energy consumption of various devices, such as incandescent and compact fluorescent light bulbs.

For information about the first SOTB™ see our Winter 2009 newsletter at www.schatzlab.org/docs/v4n4_dig_sm.pdf. For more information about similar portable power systems go to www.schatzlab.org/projects/real_world/stack_in_box.html.

Instructor Ron Poor with Southwestern Community College's new Stack-Outside-the-Box™. *Photo credit Southwestern Community College.*



Biomass Meeting *(continued from first page)*

practice of simply piling and burning woody material from forest fuel reduction projects and logging activities.

In addition to the torrefier demo, the April 7 meeting included a round table session, with ten individual presentations by attendees, and a tour of SERC's new research facility. The meeting was a chance for SERC and RFT to show off a promising new technology to foresters eager to find solutions to the wildfires that plague western forests. "The unit works great, and we're looking forward to a long-term collaboration with RFT on this research," said SERC's project manager Greg Chapman. "The Forest Service and forest industry people showed a lot of interest in the technology."



Unprocessed wood chips (front) and the same feedstock after torrefaction. *Photo credit Kellie Brown, HSU Photographer.*

and there are still many boxes to unpack, everyone is excited to have such an upgraded workspace.

There are many things to be thankful for. The daylighting in the building, something we emphasized in our request for proposals, is wonderful. The big windows in the staff offices and the conference room not only provide good indoor lighting, but give us expansive views of the surrounding campus. Our location, on a sunny hilltop surrounded by redwood trees, is a great spot and convenient to the engineering department and the rest of campus. Our outdoor lab space in the courtyard of the building has already come in very handy in housing the prototype torrefier we just acquired.

Yesterday we had a first at the Schatz lab that highlights the utility of our new building. We had two classes having labs at the center simultaneously. Charles Chamberlin's engineering class was gathered in the conference room discussing their lab assignment, measuring the heat balance in a fuel cell, an experiment they later completed in our main lab. Meanwhile, Han-Sup Han's forestry class was getting a tour of the torrefier. This could have never happened in our old space.

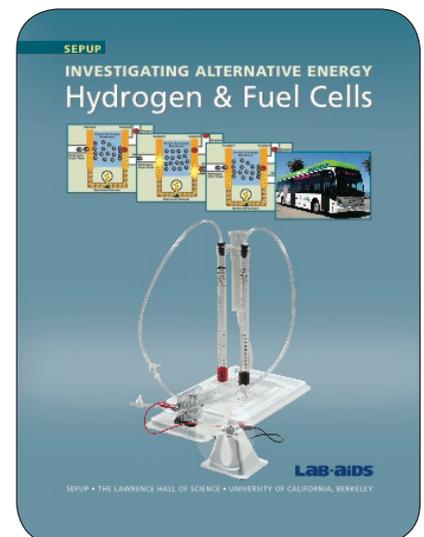
We're planning our grand opening celebration in late summer. We'll have details in our next newsletter.

HyTEC

We are excited to announce that the Hydrogen Technology and Energy Curriculum (HyTEC) project's high school chemistry module titled, *Investigating Alternative Energy: Hydrogen & Fuel Cells* was published by project partner Lab-Aids, Inc. in March 2011 (see the cover, below). The module is comprised of six activities and introduces students to hydrogen and fuel cells in the context of energy for transportation.

The publication of the module is the culmination of six years of hard work between SERC and Lawrence Hall of Science (LHS). There have been many meetings, teacher training workshops, and iterations with Barbara Nagle and her colleagues at LHS. It's rewarding to see our curriculum published and available to high school students across the country.

This summer, SERC will host a two-day teacher training for Humboldt and Del



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Project Updates

SERC Building



Photo credit Kellie Brown, HSU Photographer.

We made it! After years of planning and several false starts, the SERC staff moved into our new home during the week of January 18th. Though we're still getting acquainted with our new lab

Project Updates *(continued from page 3)*

Norte County high school teachers who would like to implement the *Hydrogen Fuel Cells* module. For information and to register, visit www.schatzlab.org/education/education_equipment.html.

For more information about HyTEC, visit LHS's Science Education for Public Understanding Program web page at <http://sepuplhs.org/high/hydrogen/index.html> or the Lab-Aids, Inc. web page at www.lab-aids.com/catalog.php?item=P310.

RESCO

A flurry of activity continues on the Humboldt County Renewable Energy Secure Community (RESCO) project. We have completed the bulk of our engineering and economic analyses and are preparing interim project reports on each of these tasks. Key lessons learned from our work to date are: (1) we can meet a large portion of our energy needs using local renewable energy resources; (2) we can do this at a modest overall cost increase; (3) we can greatly reduce our greenhouse gas emissions; and (4) renewable energy development will result in a substantial net increase in local jobs and economic output.

These are exciting results. In nearly all scenarios we have examined there are a number of resources and technologies that rise to the top. These include energy efficiency, biomass, wind, small

hydroelectric power, and the adoption of electric vehicles and heat pumps. We are now working with our stakeholder group to identify community preferences regarding how we should proceed. This information will guide the development of the RESCO strategic plan and the pursuit of near-term next steps.

In addition to our analysis work we have begun to engage the community in our RESCO planning efforts. In December and March we delivered RESCO presentations as part of the [Sustainable Futures Speaker Series](#) at Humboldt State University. Then, in April, we delivered a RESCO presentation at the annual Plant Green Conference and solicited audience input on their preferred decision criteria and preferred energy options. And, with a keen eye to the future, we engaged a youth stakeholder group that developed their own RESCO vision statement and RESCO decision criteria. The RESCO youth stakeholder group was led by Shanna Atherton, a VISTA volunteer and the Education and Outreach Coordinator at the Redwood Coast Energy Authority, and Jordan Ludtke, a senior at Eureka High School. Kudos to the great job they have done engaging our local youth in the creation of their energy future.

Note that this community engagement work will continue through the fall of this year, so stay tuned for your opportunity to get involved in Humboldt County's renewable energy future.

Looking Back

4 years ago...SERC helped United Indian Health Services (UIHS) develop the project concept and secure funding to install a large solar electric system on the roof of the Potawot Health Village, UIHS's headquarters in Arcata. SERC also provided UIHS with quality assurance testing of the 40 kW solar electric system and a data acquisition system that allows on-site and remote monitoring of the system's energy production. For more information visit www.schatzlab.org/projects/community/uihs.html.



Photo credit SERC.

[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 Fuel Cell and Hydrogen Energy 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, Christopher Carlsen, Greg Chapman, Richard Engel, Ruben Garcia, Meg Harper, Robert Hosbach, Patricia Lai, Marc Marshall, Brendon Mendonca, Tirian Mink, Allison Oakland, Carolyn Ortenburger, Kyle Palmer, Tom Quetchenbach, Kristen Radecsky, Mark Rocheleau, Lucas Scheidler, Charlie Sharpsteen, Colin Sheppard, Zack Stanko, and Jim Zoellick.

Visit us at www.schatzlab.org E-mail: serc@humboldt.edu