



SERC

ENERGY NEWS

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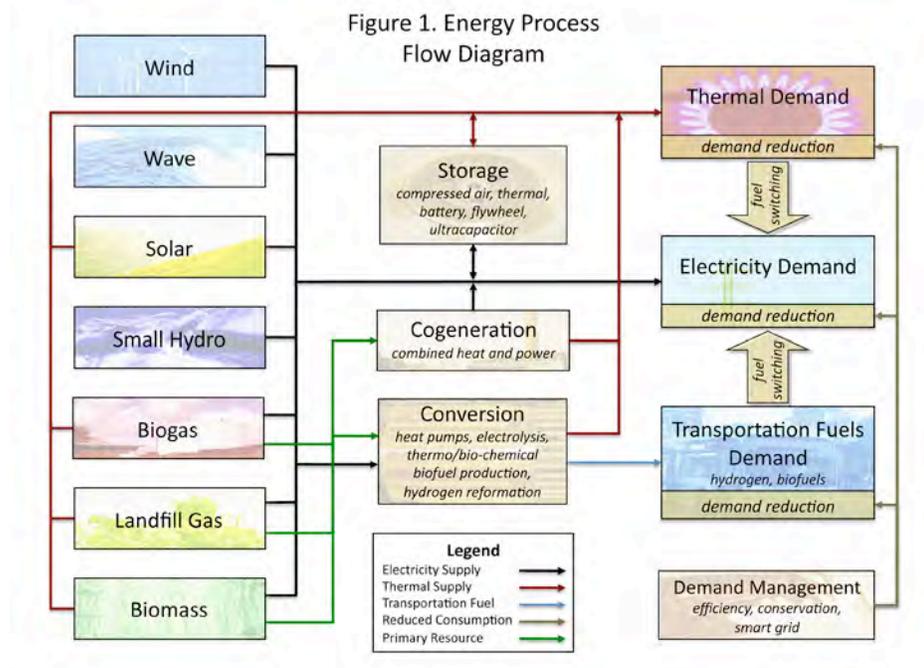
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How much of Humboldt County's energy needs could be supplied by wind and wave energy? At what point would the local electricity grid become unstable due to the intermittent nature of these resources? How many biomass power plants would be necessary to buffer these resources? Should we invest in energy storage technologies or increased transmission to the rest of California? How much would this all cost?

Humboldt County shows great promise for a clean, sustainable, renewable energy future, but the solution to our energy problem is not simple or self-evident. As illustrated in Figure 1, below, we could supply our energy needs from many different renewable sources. Also, we could adopt many different strategies for reducing consumption, shifting fuel types, storing energy, and more. There are many complicated and unanswered questions that prevent us from knowing which options are possible, let alone cost-effective.



In an attempt to tackle these questions, SERC is partnering with the Redwood Coast Energy Authority, Pacific Gas & Electric Company, and HSU economist Dr. Steven Hackett to perform a detailed investigation of technically feasible and economically beneficial options for local renewable energy development. Our goal is to produce a comprehensive and strategic plan for renewable energy development in Humboldt County.

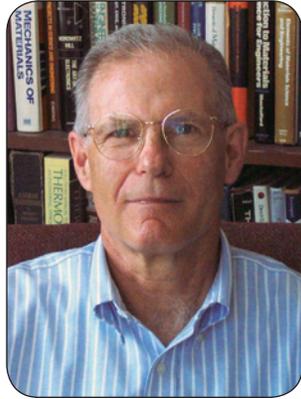
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The quarterly newsletter of the Schatz Energy Research Center

HUMBOLDT
STATE UNIVERSITY

A Message from the Director Peter Lehman

Well, that didn't last long. The honeymoon that new Secretary of Energy Steven Chu enjoyed has ended, at least among hydrogen energy researchers and advocates. With the announcement that funding for the hydrogen fuel cell vehicle program has been eliminated in DOE's 2009-10 budget request, Chu caused consternation, even anger, in the hydrogen world.



Chu explained his choice by saying that when he asked himself the question of whether or not hydrogen fuel cell vehicles would contribute to our economy in 10 to 15 or even 20 years, the answer, he felt, was "no." Instead, Chu wants to focus funding on plug-in hybrids and battery technology.

Reaction was quick to come. During a Senate hearing, long-time hydrogen supporter Senator Byron Dorgan (D-ND) vowed to block the cut, saying that he was "stunned" that Chu was zeroing out hydrogen programs. Dorgan told Chu that, "We are going to do everything we can to continue the programs."

Car companies also responded. Honda, Toyota, and GM, all of whom have strong, self-funded fuel cell vehicle programs, announced that they would continue their development. At the recent National Hydrogen Association meeting, I had the experience of driving Honda's latest fuel cell car, the Clarity. In my opinion, it's the best car ever built--powerful, quiet, very efficient, and good looking. I think people will line up to buy cars like the Clarity, once the infrastructure is in place and the price comes down.

Chu is right that developing plug-in hybrids and electric cars is a good idea. But eliminating funding for fuel cell vehicles is wrongheaded. My colleague Joan Ogden said it well, "There are uncertainties with both these technologies (batteries and fuel cells), so taking one off the table seems shortsighted."

While the fur flies in Washington, we continue working hard. In our lead article, Colin Sheppard describes the exciting RESCO project that will begin shortly. We'll be developing a renewable energy action plan for Humboldt County. Summer interns Garren Sparks and Matt Bray describe their work to provide solar power to a BLM cabin in the remote King Range along California's Lost Coast.

Best wishes to all for an enjoyable summer. I hope you capture some solar energy during those long summer days.

Solarizing the BLM's Kaluna Cabin Matt Bray and Garren Sparks

Recently the Bureau of Land Management (BLM) contracted with SERC to design and install a photovoltaic (PV) system for the Kaluna Cabin. Located in California's rugged King Range National Conservation Area in southwestern Humboldt County, the Kaluna Cabin overlooks the Kaluna cliffs and the mighty Pacific Ocean. Acquired by BLM in the 1990's, the cabin is used to showcase the natural beauty and ecological importance of the area to visiting government officials, dignitaries, and non-profit groups. The cabin has no electricity, and propane is used for lighting, refrigeration, hot water, and cooking. BLM staff decided that an off-grid PV system to provide electricity for lighting and small electronics could improve the usability of the cabin as well as decrease fire hazards associated with using propane for lighting.

The goals of the PV system design are to provide lighting and the ability to run low load electric devices. The BLM already has some surplus PV equipment originally procured for a previous project, including eight 75-Watt modules, a charge controller, and a DC load center. To evaluate the condition of the unused modules after eight years in storage, we generated current-voltage (IV) curves for each module using SERC's new PV module testing station. All modules performed well, generating around 10% below manufacturer rated output, which is common even for new modules.

With help from SERC student research assistants Patricia Lai and James Apple, we have produced a range of PV system design options offering various levels of lighting and small appliance capacity. One design also provides enough power to permit replacement of the propane refrigerator with an efficient electric model. BLM is in the process of selecting one of our designs, and installation is scheduled for completion in late August. We will also develop an interpretive sign for BLM that will inform Kaluna visitors about how the system works and the environmental benefits of using solar.

We're still climbing: Schatzers Peter Lehman and Jim Zoellick on the summit of Mt. Adams, the third largest--after Rainier and Shasta--of the Cascade volcanoes. Mt. Rainier is in the distance. *Photo by Olivia Cussin.*



The project is funded mainly by the California Energy Commission's Renewable Energy-based Secure Communities (RESCO) Program. Our local Humboldt County Headwaters Fund and SERC are contributing matching funds.

The RESCO project task list is an ambitious one:

- Perform an in-depth assessment of local renewable energy resources, as well as local energy consumption trends.
- Develop a modeling framework for analyzing the impact of a wide range of local renewable energy portfolio scenarios on grid reliability.
- Research the costs associated with supplying 75-100% renewable electricity and meeting a large fraction of transportation and heating needs with renewable sources.
- Analyze the impact of renewable energy development on the local economy.
- Conduct a stakeholder analysis, inviting the input of community members and energy developers.
- Produce a plan for Humboldt County with recommendations for realistic and economically beneficial next steps for renewable energy development.

This is a tall order to fill, but this kind of project is not new to SERC. In 2005, we worked with a local consulting team to develop an Energy Element for Humboldt County's General Plan update, which will shape local energy policy for the next twenty years. To guide creation of the Energy Element, SERC prepared a background technical document that examined energy use, energy infrastructure, and energy resource potential in Humboldt County.

The background technical report found the following characteristics associated with Humboldt County's current energy picture:

- Humboldt County is like an energy island, with minimal connections to the larger electricity and natural gas grids.
- Over a third of our primary energy use is for transportation.
- A fifth of our primary energy use is for natural gas heating and industrial process needs.
- Over 40% of our primary energy use goes toward electricity generation.
- About three quarters of our electricity is generated locally, largely using biomass resources (wood waste from the forest products industry).
- Large wind, wave, and biomass energy resources are available locally and could supply all of our energy needs, including electricity, heating and transportation.

These characteristics represent exciting opportunities for shifting demand and developing our local resources. Humboldt County could serve as an example to the rest of the country and the world of how to overcome the technical and financial challenges to renewable energy development. SERC is delighted to be a part of Humboldt County's transition toward sustainability and prosperity based on renewable energy.

Project Updates

Gasification System James Apple

For the past two years, SERC has been investigating biomass gasification for the Indonesian Sugar Group. Bagasse, a fibrous sugar cane waste product, is burned inefficiently in boilers at the Sugar Group factory. An alternative is gasification, a process of partially oxidizing biomass to produce combustible gases that can be burned cleanly and efficiently in a turbine to produce electricity. We are testing the feasibility of gasifying bagasse in a small-scale gasifier at SERC and investigating the economics of larger gasifiers that could be used by the Sugar Group.

SERC's gasifier is designed for wood, so we used Douglas Fir and Tan Oak wood chips for our first twelve gasification trials. We used these trials to become comfortable operating the gasifier and to investigate the effects of fuel moisture content on the gasification process. We found that moist wood is consumed more slowly, producing lower concentrations of combustible gases than dry wood. Lower fuel consumption tends to offset lower power output so that overall efficiency does not change significantly with fuel moisture content.



Graduate student research assistant Joe Purdon and student research assistant James Apple observe the flare during a bagasse gasification trial.

After completing our wood-fueled trials, we moved on to bagasse. As Joe Purdon explained in our spring 2009 newsletter, bagasse was transported from Texas and sun-dried at SERC. We shipped sun-dried bagasse to Biomass Briquette Systems in City of Industry, California, to produce bagasse briquettes. We tested these briquettes in SERC's gasifier, and we discovered that bagasse briquettes gasify differently than wood chips. Briquettes tend to expand inside the gasifier, forming a solid shelf that obstructs fuel flow. We used smaller briquettes in our second and third trials, and we achieved gasification for about one hour before the shelf was formed. We are now looking for new ways to gasify bagasse briquettes, and we also plan to gasify loose bagasse. We'll keep you apprised of these efforts in a future issue of our newsletter.

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Hydrogen Fueling Station Update Andrea Allen

The final troubleshooting is complete at the Humboldt State Hydrogen Fueling Station. We are now producing and dispensing hydrogen gas reliably. Dave Hoskins, equipment technician at the Telonicher Marine Laboratory in Trinidad, CA and the primary Prius driver, is now able to refuel the Prius unassisted. The station is running as designed with no operator intervention, and the data acquisition system now allows for remote data collection.

In April we traveled to Columbia, South Carolina to present operational data at the annual National Hydrogen Association (NHA) Hydrogen Conference and Expo. I presented data on the amount of hydrogen the fueling station produces on a monthly basis, the total energy required to produce the hydrogen, and the amount of energy used individually by the electrolyzer and compressor. These data are important for researchers using economic modeling to study hydrogen transportation. Even though the HSU fueling station is small compared to other stations, and our data are not necessarily representative of the energy requirements to produce and compress hydrogen gas, we hope to start a trend among fueling stations to more openly share data. We think such a trend will serve to benefit the hydrogen community.

Looking Back

5 years ago SERC collaborated with the Yurok Tribe to install a demonstration solar electric system at a remote homestead on the Yurok Reservation. The solar electric system is nominally rated at 1.5 kW DC and is designed to produce an average of 4.5 kWh per day. The system was designed and installed by two HSU students serving as SERC summer interns, assisted by two Yurok Tribe high school students. For more information on SERC's work with the Yurok Tribe visit www.schatzlab.org/projects/community/yurok_re.html



Welcome New SERC Faculty Research Associate

All of us at SERC are pleased to welcome Dr. Steven Hackett, professor of Economics at HSU, as a new SERC faculty research associate. Steve teaches courses in energy and natural resources economics and is an active faculty member in the Energy, Environment, and Society graduate program. He is author of the textbook *Environmental and Natural Resources Economics: Theory, Policy and the Sustainable Society* (New York: M.E. Sharpe, 2006), which has been adopted at colleges and universities in the US and abroad.



Steve's first duty at SERC will be to lead the economic portion of the RESCO project (see front page for more information about RESCO), which includes the development and application of economic impact assessment models to the energy sector of our regional economy and qualitative analyses of the economic development potential resulting from creating a renewable energy cluster in Humboldt County. We're looking forward to working with Steve on this and future projects.

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. Research and administrative staff include Andrea Allen, James Apple, Matt Bray, Greg Chapman, Richard Engel, Ray Glover, Meg Harper, Peter Johnstone, Steven Hackett, Patricia Lai, Marc Marshall, Allison Oakland, Joe Purdon, Mark Rocheleau, Scott Rommel, Colin Sheppard, Garren Sparks, Alina Taalman, Jennifer Tracy, and Jim Zoellick.

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