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The twice annual newsletter of the Schatz Energy Research Center

HUMBOLDT
STATE UNIVERSITY

A Clean Energy Microgrid for the Humboldt County Regional Airport

Peter Lehman and Maia Cheli

This February, the California Energy Commission (CEC) announced a \$5 million grant award through its EPIC program that will support \$6 million in match funding from the Redwood Coast Energy Authority (RCEA) for development of the Redwood Coast Airport Microgrid. Designed by the Schatz Center, this solar plus storage microgrid system will provide an energy lifeline in the event of a natural disaster. Composed of a 2.3 megawatt photovoltaic array and an 8 megawatt-hour battery storage system, the microgrid will support 18 electric accounts including the airport and the U.S. Coast Guard Air Station.



Aerial view of the Humboldt County airport

The Humboldt County airport serves 50,000 flights a year and 140,000 customers, including commercial, private, and emergency medical flights. The Coast Guard Air Station Humboldt Bay provides search and rescue for 250 miles of rural coastline, from the Mendocino-Sonoma county line to the California-Oregon border. Since roads into and out of Humboldt County are often closed by fires and slides, energy stability at the regional airport is crucial.

As the first multi-customer microgrid in Pacific Gas and Electric's service territory, the project will provide a test bed for the policies, tariff structures, and operating procedures necessary to integrate microgrids into California's electric grid. Lessons learned will help the state strengthen its power grid by creating a road map for microgrid integration across the state.

One of the first steps in this project, required by the CEC, was to complete the California Environmental Quality Act (CEQA) assessment for the microgrid. Hank Seemann of Humboldt County Public Works prepared the CEQA Mitigated Negative Declaration and it was approved by consent by the Humboldt County Board of Supervisors at their May 8 business meeting.

We are currently working with RCEA and the U.S. Department of Agriculture's Rural Utilities Service to finance RCEA's match for the project. This includes satisfying Section 106 of the National Historic Preservation Act, which involves contacting the local Tribes and California's State Historical Preservation Officer to make sure no items of historical significance are affected. We also need approval of the Federal Aviation Administration to move forward with the project, as ACV is a federally obligated airport. Those efforts are ongoing and we're making good progress!

A Message from the Director *Arne Jacobson*

On May 4, we had the pleasure of hosting the Schatz Center Advisory Board for our annual meeting. In addition to our customary discussion of Center activities and strategy, we were happy to be able to include the Advisory Board members in a dedication ceremony for our new building addition, which we have been calling the ‘West Wing.’



During the meeting, we reported our progress toward the Center’s strategic goals—which are derived from our mission to promote clean and renewable energy—and discussed our portfolio of projects, budget, staffing, and space within this context. We were able to report good news to the Advisory Board in multiple spheres.

We noted that our two most active project areas are those related to (i) renewable energy microgrids, grid integration of renewable energy, and associated demand-side management strategies and (ii) improved access to energy in off-grid and marginal grid communities in Sub-Saharan Africa and South Asia. Together with our partners, we have received recognition for our efforts in both areas: in January alone, the Blue Lake Rancheria renewable energy microgrid was awarded the [Project of the Year for Distributed Energy Resources](#) at the annual DistribuTECH conference in San Antonio, Texas, while our energy access team simultaneously played a key role at the premier international conference for the off-grid solar sector, the [Global Off-Grid Solar Forum and Expo in Hong Kong](#). We also have current projects and activities in bioenergy, clean transportation, off-shore wind, energy efficiency, hydrogen energy, clean energy policy, and education/outreach. Our staff expertise continues to deepen,



Schatz Advisory Board members (left to right): Andrea Tuttle, Rick Duke, Jeff Serfass, Jack West, Christina Manansala West, David Rubin, David Katz, and Denise Helwig, and Directors Charles Chamberlin, Peter Lehman and Arne Jacobson. Not pictured: Dan Kammen and Jaimie Levin.

and we have ample opportunities for continued work in pursuit of our mission.

Regarding staffing, we have a motivated, skilled, and professional team, and their strengths provide the foundation for our success. Recent additions to the Schatz Center include Dr. Nicholas Lam (research scientist), Kaileigh Vincent-Welling (engineering technician), Richard Williams (engineering technician), and Jessica Ramirez (administrative assistant). We are pleased to welcome them to our team. During the advisory board meeting, we discussed two strategic foci in relation to personnel. We began by noting the importance of expanding our team’s project management capacity to meet the needs of our growing work portfolio. We then discussed our commitment to increasing staff diversity and ensuring a broadly welcoming work environment. We appreciate our board’s thoughtful advice, and we look forward to

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Solar+ Kickoff *Peter Alstone*

This April, under a warm and welcome sun, our team joined the Blue Lake Rancheria (BLR) to break ground on their second microgrid.

The BLR Solar+ project will create a first-of-its-kind microgrid, designed to best fit the parameters of a gas station and convenience store. These small businesses are well-suited for projects with solar, storage, and advanced building controls (Solar+), but microgrid integration is typically out of their reach, given the custom design and engineering involved. This project is a partnership between the Schatz Center, Lawrence Berkeley National Laboratory, and the BLR to develop and pilot test new, scalable approaches in hardware and software, to help advanced microgrids reach these and other small commercial buildings. This could be the first of thousands of resilient, solar gas stations—there are 12,000 stations in California alone, many of which will transform in the coming decades as [EV charging reshapes transportation infrastructure](#).

We would like to thank the Blue Lake Rancheria for hosting this event, and for their ongoing leadership in sustainability. The Solar+ project exemplifies how the Schatz Center is working to bridge cutting-edge clean energy research with the needs of deployment. Construction will begin this summer, and we expect that the pilot facility will be operational in 2019, helping us to learn about the capabilities and potential of solar plus storage.

Clean Energy Education

Spring 2018 Outreach

We've been busy with education events this semester! January kicked off with a hydrogen fuel cell workshop for the [GATE Academy](#), coordinated annually by the Humboldt County Office of Education. In February, Girl Scout Troop 90020 visited us to learn *Watts Up?* about power and energy. In March and April we offered solar lighting repair workshops for HSU's Renewable Energy Student Union and the Campus Center for Appropriate Technology.

In April, we joined Arcata, Freshwater, and Lafayette elementary schools for their environment & science fairs, and participated in HSU's Power Down and the Party for the Planet at the Sequoia Zoo. We also held onsite programs for prospective HSU freshman and transfer students, Eureka High's engineering class, and HSU engineering majors. At the end of May, we presented our *Watts Up?* program at the [Redwood Environmental Education Fair](#), an event for 3rd to 8th graders held each year at the College of the Redwoods.

Our outreach program offers hands-on energy workshops for youth through adults (4th grade and above) year-round. For more information, email us at serc@humboldt.edu or call (707) 826-4345.



Students explore solar circuits at the Redwood Environmental Education Fair

Tours at Schatz

Would you like to visit the Center? Beginning in August, we'll offer regular tours from 1-2 p.m. on the first Friday of every month. Reservations are required; email serc@humboldt.edu to save your space for the next tour.

Visiting the area? Although the Center is not open to walk-in traffic, we are glad to schedule a tour of our facilities. We can accommodate most requests made 48 hours in advance. If you're interested in learning about a specific research area or project, please let us know when you contact us.

Off-grid Solar Workshops *Kaileigh Vincent-Welling*

The Schatz Center presented two off-grid solar education workshops this spring. The first workshop was hosted at the Center and included students from the [Renewable Energy Student Union](#) (RESU), a campus engineering club. The second was held at the [Campus Center for Appropriate Technology](#) (CCAT) and was open to the public. Participants learned about solar energy and the off-grid energy access work we do here at Schatz, followed by hands-on instruction in how to fix solar products. These products had previously undergone testing in our off-grid solar lab as part of the [Lighting Global Quality Assurance](#) program. This program provides quality assurance for solar products going onto the market in Africa and Asia, which protects buyers, prevents market spoilage, and promotes consumer awareness.



Off-grid solar workshop: repairing LED lamps for home use

Attendees received their own solar product to fix—which entailed reconnecting cut electrical wires between each product's battery and the rest of its circuitry—and at the end, each person walked away with a fully-functioning solar lighting product. We plan to have more of these workshops to share with our community, as we've received a lot of positive feedback!

Faculty News

PETER ALSTONE, Schatz Faculty Scientist and Assistant Professor of Environmental Resources Engineering

- Humboldt State's ERE department offered its first course focused on "The Grid" this spring. Taught by Peter Alstone, the class covered the basics of the electric power grid, renewables integration, and designing distributed systems. Thirty students participated, with coursework culminating in two projects: one analyzed the potential to integrate large-scale solar and wind power in the Humboldt County electricity system, and the other developed a design for scalable and repeatable building upgrades that include solar, batteries, and advanced building controls.
- Peter is participating in the [Load Shift Working Group](#) that has been convened by the California Public Utilities Commission. Peter is serving as a technical expert along with colleagues at Lawrence Berkeley National Laboratory. The working group follows directly from a 2017 LBNL study on Demand Response potential, for which Peter was lead author.

KEVIN FINGERMAN, Schatz Faculty Research Associate and Assistant Professor of Environmental Science & Management

- In 2015, Kevin Fingerman redesigned ENV5 370, a core course for Environmental Science majors, as part of CSU's "Campus as a Living Lab" (CALL) program. Using campus buildings as a case study, students utilize energy metering tools and modeling programs to assess energy efficiency. This curriculum was featured in a [April 2018 CSU article](#) about preparing students for green jobs of the future.
- Every fall semester, Kevin teaches the capstone course for the Energy & Climate option of HSU's Environmental Science and Management major. One of the projects he conducted with his students this year [focused on the greenhouse gas impacts of cannabis cultivation](#)—especially timely as the industry enters its second year of legality in California. His students were nominated by HSU to participate in the California State University student research competition, where they took home the [second place award](#) in the interdisciplinary category.
- Kevin serves on the Board of Directors of the [Roundtable on Sustainable Biomaterials](#), helping to manage a global certification standard aimed at improving the environmental and social performance of the growing bioeconomy.

STEVEN HACKETT, Schatz Faculty Research Associate and Professor of Economics

- Steve Hackett recently completed a [three-year technical report](#) that focused on baseline and initial socioeconomic

change in the context of North Coast marine protected area formation.

- Steve is currently working with Laurie Richmond on a fishing community sustainability plan project, and a project on the economics of the Humboldt Bay oyster industry.

From the Fellows *Steven Shoemaker*

I am a graduating recipient of the [Blue Lake Rancheria Fellowship for Clean Energy Studies](#) in the Energy, Technology & Policy program here at Humboldt State. My master's thesis investigated the impacts of changes made to solar net metering by northern California community choice aggregators.



The BLR microgrid consists of 420 kilowatts of solar and 950 kilowatt-hours of battery storage. My role has been to analyze the microgrid's impact on the Rancheria's monthly electricity bills.

Many California electricity users, including the Rancheria, are on "Time-of-Use" rates—meaning that electricity is charged differently depending on what time of day it is consumed. Microgrids are uniquely positioned to lower such charges. In solar + storage systems like the BLR microgrid, the photovoltaic array and the battery storage system can be managed to reduce the amount of energy purchased during high priced periods. Our team calculated and verified how the BLR microgrid's solar + battery setup is providing significant annual savings to the Rancheria.

Evaluating how renewable energy projects can respond to price signals is a critical area of research, and my goal is to use this experience to help develop and implement forward-thinking utility rate structures that support both renewable energy and the grid at large.



Blue Lake Rancheria microgrid solar array

Project Updates

California Biopower Impact (CBI) *Kevin Fingerman*

Work is ongoing on the California Biopower Impact (CBI) project. Supported by a three-year \$1,000,000 grant from the California Energy Commission, our project is quantifying the greenhouse gas (GHG) impacts associated with utilization of in-field forest and agricultural residues for electricity and heat generation. Our collaborators at the University of Washington have completed their geospatial statewide assessment of forest residue generation from different forest management activities, and we are at work integrating this data into our life cycle GHG accounting framework and tool. In parallel, groups from the project team are investigating additional critical considerations associated with biomass-to-energy pathways—including altered risk or severity of wildfire, soil fertility and carbon efflux impacts, changes to air quality, residue utilization economics, and best practices for forest residue management.

In May, California Governor Jerry Brown [issued an executive order](#) aiming to “combat dangerous tree mortality, increase the ability of our forests to capture carbon and systematically improve forest management.” The state expects to allocate significant funding in the coming years for forest health improvements and fire management. Our project is well-positioned to help guide whether, and under what circumstances, bioelectricity should play a role in these forest management efforts.

Evaluation of Biomass Conversion Technologies *Mark Severy*

We recently completed work on the Waste to Wisdom project that examined the entire supply chain of converting forest waste residues into bioenergy and wood products. The Center’s role was to evaluate equipment that produces biochar, torrefied biomass, electricity, or densified wood briquettes using forest residues as the input feedstock. Collaborators from Humboldt State’s Forestry Department analyzed the upstream collection of forest biomass, and experts from the U.S. Forest Service conducted a life cycle assessment and economic analysis of the supply chain.

Data collected by the Schatz Center during field tests of biomass conversion equipment were used to identify optimal process conditions, specify feedstock limitations, measure emissions, evaluate product quality, and recommend design improvements to equipment manufacturers.

Results and conclusions from the entire project were presented in a special issue of *Applied Engineering for Agriculture*, published in February. Four principal investigators, including Schatz Center Director Arne Jacobson, summarized the project’s objectives and major conclusions in the introduction article

to the special issue. Engineers from the Center authored four papers, on biochar production, torrefaction and briquetting, and gasification of forest residues.

Collaborators at the U.S. Forest Service and the Consortium for Research and Renewable Industrial Materials (CORRIM) used the results collected from testing activities to conduct economic and environmental life cycle analyses of biomass conversion technologies. Field measurements from the Waste to Wisdom project will also be included in our current California Biopower Impact project, which is evaluating the environmental impacts associated with utilization of forest-derived woody biomass for electricity generation.

For more information, or to download the papers, visit schatzcenter.org/news/2018/02/bctpapers.

Presentations

Distributech 2018

The 2018 [Distributech Conference and Exhibition](#) took place from January 23-25 in San Antonio. Managing Research Engineer Dave Carter represented the Schatz Center at the opening plenary session, in which the Blue Lake Rancheria Microgrid was awarded the [2018 Project of the Year Award for Distributed Energy Resource Integration](#).

Later, as part of a panel on challenges and innovations in site-owner microgrids, Dave joined Jana Ganion, Sustainability and Government Affairs Director for the Blue Lake Rancheria, to present *Lessons & Benefits from the First Year of Operations for the Blue Lake Rancheria Microgrid*. Microgrids were a hot topic at the conference, which included 316 utilities, 11,481 registered attendees from 71 countries, and 520 exhibits.

Global Off-Grid Solar Forum & Expo

Schatz Center team members Kimberly Thorpe, Richa Goyal, Scott Toyama, Arne Jacobson, Nick Lam, Christopher Carlsen, and Kristen Radecsky traveled to Hong Kong in January to attend the [Global Off-Grid Solar Forum and Expo](#) organized by GOGLA and the World Bank/IFC Lighting Global program—the fifth of its kind since 2008. The event serves as a platform for sharing the latest information in the off-grid energy sector as well as brainstorming how to best support the industry to reach our common goal of providing quality energy applications to off-grid areas. The Schatz Center has played a lead role in this effort since 2006, and became the Lighting Global Quality Assurance Technical Lead in 2009.

The Schatz team shared new research via sessions in *Technical Advances in the Off-Grid Sector*, *A Peek into our Rural Customer Base*, and *E-waste and Environmental Responsibility*. The event also showcased productive applications including efficient solar

Presentations (continued from page 5)

milling machines, water pumping, and refrigeration. Conference participants included product manufacturers, members from ten international test laboratories, and representatives from 65 countries, working together to ensure that quality products reach their communities.



Members of the Lighting Global Test Laboratory Network following the expo

California Offshore Wind Industry Summit

The [2018 California Offshore Wind Industry Summit](#), held on March 13 in Sacramento, featured representatives from the offshore wind (OSW) industry, government, environmental organizations, supply chain companies, and academic leadership to discuss the future of floating OSW energy in California.

The conference was structured around a series of panel presentations followed by discussions with conference attendees. Schatz Managing Research Engineer Dave Carter [presented info on the north coast region](#) as part of an OSW research and development panel. Humboldt County featured prominently at the conference due to our region's world-class wind resource, the [Navy's recent decision](#) to block OSW development south of the Monterey Bay due to potential conflicts with military missions, the Port of Humboldt Bay's suitability for OSW deployment, and the Redwood Coast Energy Authority's [developing engagement with wind projects](#).

California IEPR Workshop

The California Energy Commission (CEC) held an [Integrated Energy Policy Report \(IEPR\)](#) workshop at the Arcata D Street Community Center on April 20. The workshop was designed to gather north coast energy perspectives and was led by CEC Commissioners Karen Douglas and David Hochschild. This was the first IEPR workshop ever to be held in the north state region.

The workshop consisted of three sessions. The first opened with

presentations by the Redwood Coast Energy Authority (RCEA), the Yurok Tribe, Humboldt State University (HSU), and the Schatz Center. Speakers reviewed energy progress in our local area including planning, energy efficiency, the launch of our community choice aggregation program, renewable energy development, and student involvement.

The second session addressed the thriving microgrid development on the north coast. Speakers from the Blue Lake Rancheria (BLR), the Schatz Center, and Pacific Gas & Electric (PG&E) described the BLR microgrid project as well as upcoming microgrids for the Humboldt County airport, the BLR gas station/convenience store, and the Humboldt Transit Authority. Commissioners Douglas and Hochschild expressed encouragement for the progress being made in microgrid development and implementation.

The final session concerned plans now taking shape to develop the enormous offshore wind power potential of Humboldt County. Representatives from the Bureau of Ocean Energy Management (BOEM), the CEC, the U.S. Navy, PG&E, and RCEA weighed in on both the wind potential and the obstacles that must be surmounted to develop this very promising renewable energy resource for California.

Microgrid 2018

The [Microgrid 2018](#) conference was held from May 7-9 in Chicago. Jim Zoellick, Managing Research Engineer at the Schatz Center, [presented on the Redwood Coast Airport Microgrid project](#) during a breakout session moderated by H.G. Chissell, Founder and CEO of Advanced Energy Group. The conference hosted nearly 400 participants over a three day period, and focused on markets and models for microgrids that can serve the greater good. Speakers and panelists explored policy, regulation, financing, business opportunities, and real-world uses of microgrid technology.

Many states are now pursuing efforts to make way for the development of microgrids—including Illinois, where the new Bronzeville microgrid will be installed near Chicago. Like our Humboldt County Airport microgrid, the Bronzeville project will be a front-of-the-meter, multi-customer system. It will also be integrated with a nearby microgrid in Champaign. These projects reflect efforts by Illinois utilities, regulators, and residents to move toward the smart grid of the future. A key example of their effort is the [NextGrid: Illinois Utility of the Future Study](#), an 18-month, consumer-focused investigation addressing challenges that face the state's electric grid, its users, and the utilities who operate it. Kudos to Illinois for their progressive efforts!

West Wing Dedication

We formally dedicated our West Wing addition on May 4. Congressman Jared Huffman was joined by HSU President Lisa Rossbacher, Blue Lake Rancheria Tribal Council Member Jason Ramos, and Schatz Advisory Board members Jack West and Andrea Tuttle to celebrate the Center's expansion.

The 1900 square foot addition is located immediately west of the main building, and includes two faculty offices, a conference room, and fourteen staff and student workstations. This increase in space has enabled the Schatz Center to hire nine additional student research assistants for summer 2018 to work on projects in wind energy, smart grids, biomass assessment, and off-grid energy access.

The dedication ceremony was followed by an open house with demonstrations in solar product testing, biomass energy, and microgrid management systems, an unveiling of interpretive photo galleries newly installed throughout both buildings, and the official deployment of the [first electric vehicle charging station on the HSU campus](#).

The Schatz Center's West Wing was designed by Suarez Kuehne Architecture of San Francisco and built by a team led by Adams Commercial General Contracting of Eureka. Humboldt State University Facilities Management coordinated the design and construction process.

The project was fully funded by donor contributions, including major support from the estate of Louis W. Schatz, additional gifts from Anne and David Katz, Peter and Carolyn Lehman, Christina and Jack West, Jamie Everett, and Joel Lehman, and grant funding from the California Energy Commission.



Summer 2018 Schatz Center student research assistants (left to right): Cassidy Barrientos, Tanya Garcia, Ellen Thompson, Sabrinna Rios Romero, Karsten Hayes, Anh Bui, Chih-Wei Hsu, Craig Mitchell, and Rene DeWees

Gifts for Education

Recent major contributions include support for the the Donald and Andrea Tuttle and the Blue Lake Rancheria [fellowships for Clean Energy Studies](#).

The Schatz Center also provides programming for over 500 students in 4th-12th grades each year, and work opportunities for students in engineering, environmental resources, and related disciplines at Humboldt State. You can support clean energy education by contributing to our fellowship & education fund: donate online at schatzcenter.org/donate or call (707) 826-4345 to discuss a sustaining gift.



Congressman Jared Huffman speaks at the West Wing dedication



Schatz Advisory Board members Andrea Tuttle and Jack West (left to right)

EV Charging Station Opens at Humboldt State

On May 4, Humboldt State University unveiled its first electric vehicle (EV) charging station, located next to the Schatz Center's West Wing addition.

Gasoline and diesel transportation currently accounts for [39% of California's greenhouse gas emissions](#). Zero-emission vehicles, including EVs, directly limit both greenhouse gases and air pollution. Additionally, EV charging stations can support clean power generation. By charging their vehicles during the day, drivers can offset the solar energy "duck curve"—thus reducing the need for nighttime energy storage and allowing utility operators to incorporate more solar generation on the grid.

This first charging station was installed with funding support from HSU's Office of Research, Economic & Community Development and will serve as a pilot for the campus. Initial station rules are based on policies from California State Universities with similar parking needs and constraints. After Parking and Commuter Services has data on HSU usage patterns, a formal EV charging station policy will be created. Additional stations will be installed as parking lots undergo routine renovation.

To charge at Schatz:

The Schatz Center is located on the south side of campus, across from the Behavioral & Social Sciences building. To access the charging station, [take the driveway between the G14 and G15 lots](#) and park on the south side of the Center.

The Schatz station can provide charging for either of two adjacent parking spaces. One parking space is EV-only; parking here is limited to four hours, and the vehicle must be charging while parked. The second space is ADA parking (EV not required). [HSU parking permits](#) are required for both spaces and can be purchased from the kiosk in the G15 lot.



The new EV charging station at Humboldt State

Director's Note (continued from page 2)

a continued focus on these key issues.

And, of course, we celebrated our new building and the opportunities that it enables. Importantly, the increase in space—along with a commitment to student mentorship by faculty and staff on our team—has allowed us to hire nine summer student interns. They join seven continuing student employees, for a total of 16 students working with us this summer. This is the largest number of students working at Schatz Center at one time in the history of our organization. We are grateful for the contributions that each student is making to our work, and I thank my colleagues for all that they have done to create hands-on learning opportunities.

Happy summer solstice, and goodbye until next time.

For the latest project announcements and updates, [subscribe to our online newsletter at:](#)

schatzcenter.org/news

The mission of the Schatz Energy Research Center is to promote the use of clean and renewable energy.

The Schatz Center is led by Arne Jacobson (Director), Peter Lehman, (Founding Director), and Charles Chamberlin (Co-Director). Our team of approximately 40 people includes faculty and research associates, engineers and professional staff, student research assistants, and volunteer docents. Our expertise includes design, deployment, research, and policy development in off-grid energy access, renewable energy systems, smart grids, bioenergy, and clean transportation.

Visit us at www.schatzcenter.org E-mail: serc@humboldt.edu Call: 707-826-4345