



SERC

ENERGY NEWS

SERC Director Arne Jacobson Receives CSU's Highest Honor *Peter Lehman*

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The quarterly newsletter of the Schatz Energy Research Center

HUMBOLDT
STATE UNIVERSITY

Just before winter break, California State University Chancellor Timothy White informed SERC Director Arne Jacobson that he had been chosen to receive the prestigious Wang Family Excellence Award. This award "celebrates CSU faculty and administrators who, through extraordinary commitment and dedication, have distinguished themselves by exemplary contributions and achievements in their academic disciplines and areas of assignment." Arne received the award in the area of *Natural Sciences, Mathematical and Computer Sciences, and Engineering.*

Arne was honored in part for his groundbreaking work with the International Finance Corporation and World Bank to ensure the quality of off-grid lighting and solar home products as part of the Lighting Africa, Lighting Asia, and Lighting Global programs. As has been chronicled in this newsletter for years, Arne and his team have contributed to increased energy access for millions of low-income people in Africa and Asia. Laboratories around the world have adopted the testing protocols and quality assurance standards that were developed by the SERC team in collaboration with partner organizations.

Arne will receive his award during a ceremony at the Chancellor's Office in Long Beach on January 27. The Board of Trustees, CSU Presidents, and other guests will attend and a celebration dinner will follow. The Wang Family Excellence Award comes with a cash prize of \$20,000.

Clockwise from top right: Arne Jacobson discusses the pros and cons of solar lighting products at a focus group in Kenya. Arne, Ted Bilek, and Han-Sup Han, leaders of the \$5.8M Waste to Wisdom biomass project, observe biomass harvesting in Humboldt County. Arne and students receive their award as winners of the U.S. EPA's People, Prosperity, and the Planet competition. This led to a successful microgrid project in Bhutan



A Message from the Director

Happy New Year! I wish you all a prosperous and enjoyable 2015. The past year has been one of our most productive, and – as we head into a new one – I would like to thank the many people and organizations that made particularly important contributions to our success.



I will start by thanking the entire team here at SERC for their efforts over the past year. We have completed a prodigious amount of work, and everyone has pitched in. I am especially grateful to Allison Hansberry and Carolyn Ortenburger for their administrative and operational support. This year SERC managed more grant money and engaged with more project partners than we ever have in the past. We simply could not have done this without Allison's leadership and Carolyn's expert work.

Leading SERC in partnership with Peter Lehman and Charles Chamberlin is a pleasure and an honor. They have made immense contributions to the Center and the clean energy field since SERC was founded in 1989. Other talented faculty colleagues who have made crucial contributions to SERC's work this year include David Vernon, Kevin Fingerma, Han Sup Han, Steve Hackett, and Laurie Richmond. Additionally, we are in the process of hiring a new faculty member for a joint Environmental Resources Engineering Department/SERC position and look forward to welcoming her or him to campus later this year.

Among SERC staff members, Jim Zoellick and Greg Chapman deserve special thanks for their leadership and efforts on the RePower Humboldt project. Jim has worked tirelessly as SERC's project manager, and Greg has led the design and installation of the biomass energy system. Marc Marshall, Mark Rocheleau, Mark Severy, and Andy Harris have also made key contributions to this project. We are grateful to our project partners, including especially the Redwood Coast Energy Authority and the Blue Lake Rancheria. I would also like to congratulate the Blue Lake Rancheria for being recognized by the White House and the U.S. Department of Energy as a [Climate Action Champion](#). The Rancheria was one of only 16 U.S. communities that received this honor.

I am grateful to Colin Sheppard for his leadership and analytical work over the past year. He has helped SERC develop a robust portfolio of clean transportation work related to infrastructure development for electric vehicles while also engaging in projects ranging from wave energy development analysis to regional renewable energy deployment. Colin has also been a proposal-writing powerhouse. Kevin Fingerma, Andy Harris, Jim Zoellick, Dave Carter, and Manan Parikh have also played vital roles in

our clean transportation work.

In the six months that Dave Carter has been with us, he has expertly managed our efforts on the [Waste to Wisdom biomass energy project](#), a broad collaboration under the leadership of Dr. Han Sup Han of HSU's Forestry Department. Dave has also contributed substantively to a number of SERC's clean transportation projects and proposal-writing efforts. Mark Severy, Marc Marshall, David Vernon, and Richard Engel also played significant roles in SERC's work on Waste to Wisdom this year. Another innovative biomass energy effort at SERC involves the use of biomass feedstock to generate hydrogen fuel through a catalytic reformation process. David Vernon leads this work, with key contributions from Mark Severy and Billy Karis.

Our entire off-grid energy team has worked hard all year on our efforts to improve energy access in Africa and Asia as part of the World Bank Group's Lighting Global, Lighting Africa, and Lighting Asia programs and the U.S. Department of Energy's Global LEAP initiative. I owe Meg Harper special thanks for her leadership on a World Bank funded effort to develop test methods and quality standards for off-grid solar home systems. Kristen Radecky has also demonstrated leadership through her continued management of product testing for the Lighting Global quality assurance program. Many others have contributed substantially to this work over the past year, including Ga Rick Lee, Tom Quetchenbach, Malini Kannan, Kyle Palmer, Erik Page, Kevin Gauna, Peter Alstone, Chris Carlsen, Brendon Mendonça, Robert Hosbach, John Hunter, Ian Hunter, Patricia Lai, Nick Bryant, Amit Khare, Mark Rocheleau, Janoah Osborne, Greg Pfothenauer, and Asif Hassan. Going forward, we are excited to welcome Richa Goyal to our energy access team in the very near future.

SERC's education and outreach activities continued in 2014 under Allison Hansberry's leadership. We reached over 1,700 people in 2014, including students in K-12 schools, HSU students, and community members. Much of this work was carried out by SERC docents, in particular Yaad Rana, Greg Pfothenauer, and Robo Okumo. We all appreciate the important contributions that this work makes to our community and to the effort to increase public understanding of clean energy technologies.

Our work at SERC is truly a team effort, both within the Center and beyond. We are thankful for the support we receive from Rhea Williamson, Steve Karp, and the entire team at the HSU Sponsored Programs Foundation. We also appreciate the HSU Advancement Foundation's management of assets that are invested on behalf of SERC.

I would also like to thank the eight members of the [SERC Advisory Board](#) for their important contributions to SERC over the past year. We look forward to continued productive engagement in 2015.

Last, but certainly not least, I want to thank our many collaborators and funders for their engagement and support. Beyond HSU, some of our key partner organizations over the past year included the Redwood Coast Energy Authority; the Blue Lake Rancheria;

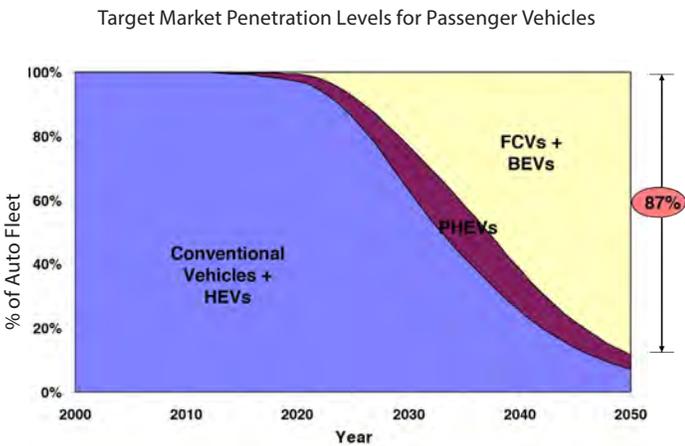
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Helping California Pursue Greenhouse Gas Reduction Goals in the Transportation Sector

Jim Zoellick

The State of California has set ambitious goals for greenhouse gas emission reductions: a reduction to 1990 levels by the year 2020, and to 80% below 1990 levels by 2050. According to the [California Air Resources Board](#) (CARB), 28% of the State's total greenhouse gas emissions are attributable to light-duty passenger vehicles. Understandably, the State has placed significant focus on reducing emissions in the transportation sector, with a key strategy being the widespread deployment of zero emission vehicles (ZEVs). This includes both plug-in electric and hydrogen fuel cell electric vehicles (FCVs), two technology areas where SERC has significant expertise.

As part of their policy analyses, CARB staff estimated that ZEV market penetration levels over the next three decades will need to reach dramatic levels in order for us to reach our greenhouse gas emission reduction goals. The figure below depicts a scenario where FCVs and battery electric vehicles (BEVs) make up a whopping 87% of the light duty auto fleet in 2050, with the remainder of the fleet being composed of plug-in hybrid electric vehicles (PHEVs), hybrid electric vehicles (HEVs), and conventional vehicles.



State sponsored efforts to encourage and even require the widespread deployment of ZEVs include regulations requiring auto manufactures to sell a minimum number of ZEVs in the State; consumer rebates for ZEV purchases; funding to support local planning for ZEVs and associated fueling infrastructure; and funding to support the installation of electric vehicle (EV) charging stations and hydrogen fueling stations.

Many of SERC's projects over the last two decades have supported these efforts. In the early days (circa 1990), SERC developed a [small fleet of FCVs and a hydrogen fueling station](#) for SunLine

[Transit](#) in Thousand Palms, CA. Later SERC provided technical support for [AC Transit's](#) fuel cell bus program, and delivered hydrogen safety trainings for emergency first responders for FCV projects around the country. SERC designed and installed a [hydrogen fueling station](#) at Humboldt State University, which has enabled SERC to operate, test, and demonstrate a Toyota Highlander FCV for the last five years.

In the last few years, SERC has been involved in several California Energy Commission funded projects to support the deployment of ZEVs. These efforts have included Plug-In Electric Vehicle Readiness projects for the North Coast region (Humboldt, Trinity, and Del Norte counties) and the Upstate region (Shasta, Siskiyou, and Tehama counties). These two projects featured the development of plans to install EV charging stations throughout these regions. SERC's work in these locales continues as we identify additional locations for EV charging stations and support the design and installation of many of these stations. In addition, we are working on a project to assess the opportunities and barriers associated with deployment of a wide array of alternative fuel vehicles in the North Coast region. This includes not only EVs and FCVs, but also biofuel and natural gas fueled vehicles.



Participants check out EVs like this Nissan Leaf at the Upstate EV101 workshop in Redding, CA.

SERC has also recently partnered with the [Transportation Sustainability Research Center](#) at UC Berkeley and others to establish the Northern California Center for Alternative Transportation Fuels and Advanced Vehicle Technologies (NorthCAT). NorthCAT will focus on education, training, demonstration, and deployment of alternative transportation fuels and advanced vehicle technologies in the Northern California region.

Watch future newsletters for updates on these projects as SERC continues to help the north state region move toward a low-carbon, sustainable transportation future.

Analyzing Opportunities for PV Systems on the North Coast

David Carter

Last spring, the [North Coast Resource Partnership](#) (NCRP) issued a call for applications from small water and wastewater service providers in disadvantaged communities to host demonstration projects. The goal was to identify projects that would serve to “beta-test” a small community resources toolkit, provide real engineering support to providers, and develop case studies to serve as examples for the North Coast region as a whole.

Technical assistance for the projects selected by the NCRP was led by [GHD Inc.](#) in Eureka, CA. SERC was subcontracted by GHD to complete a photovoltaic (PV) analysis for the Smith River Community Services District’s (SRCSD) water pumping facilities using methods that could be replicated as part of the small community resources toolkit.

The [System Advisor Model](#) (SAM), developed by the National Renewable Energy Research Laboratory, was selected because SAM is a free, robust, and well-supported analysis platform. Also, data collected with a Solar Pathfinder™ during the site visits was easily imported into the SAM model to account for shading at the proposed array locations.

SERC engineers analyzed seven of the SRCSD facilities and found that if PV systems were implemented on an individual basis, the simple payback periods ranged from 8 to 12 years, given the current incentive and pricing landscape. If the systems were aggregated together, the simple payback period would be about nine years to install 64 kW DC of PV generating capacity that could meet approximately 70% of projected SRCSD electrical loads. As a result of this work, SERC recommended that the SAM model and the Solar Pathfinder™ be incorporated into the NCRP Small Community Resource Toolkit.



Internal view of one of the seven water pumping facilities owned and operated by the SRCSD that were analyzed for opportunities to install photovoltaic systems.

Candidates for ERE/SERC Faculty Position Coming to Campus

Peter Lehman

As we’ve reported previously, the [Environmental Resources Engineering](#) (ERE) Department and SERC have been seeking a new faculty member. The successful candidate will split time between teaching and advising duties in the ERE Department and research work at SERC.

The search committee members are Arne Jacobson, Charles Chamberlin, Dave Vernon, and Peter Lehman as chair. The committee has conducted phone interviews with a pool of leading applicants and invited four excellent candidates for on-campus interviews. They will visit HSU during the last week of January and the first week of February. They’ll be meeting with faculty and administrators, teaching a class, and presenting a research seminar during a whirlwind day and a half.

The entire ERE faculty will make the final decision of the successful candidate. We hope to have a new colleague in place by next fall semester.

Director’s Comments *(continued from page 1)*

Lawrence Berkeley National Laboratory; the Transportation Sustainability Research Center at the University of California, Berkeley; the National Renewable Energy Laboratory; the Fraunhofer Institute for Solar Energy Systems; the Global Off-Grid Lighting Association; the Collaborative Labeling and Appliance Standards Program; the Forest Products Laboratory of the U.S. Forest Service; Biochar Solutions Incorporated; the Pellet Fuels Institute; Cal Poly San Luis Obispo; and the Siskiyou County Economic Development Council. Our largest funders over the past year included (in no particular order) the International Finance Corporation, the World Bank, the U.S. Department of Energy, and the California Energy Commission.

We appreciate the trust, support, and collaboration of all of these partners, and look forward to doing more good work together in 2015.

Project Updates

BRDI Waste to Wisdom: Torrefaction Partner Selected

Dave Carter

As reported previously, SERC is leading the biomass conversion technology demonstration portion of the Waste to Wisdom project. Waste to Wisdom is examining the entire biomass supply chain, from collection, transportation, and pre-treatment of the material in the woods, to the conversion of the material into energy and other marketable products. Our role is to oversee the testing and evaluation of three biomass conversion technologies: a biochar unit, a briquetter, and a torrefier.

We are pleased to announce that the **Norris Thermal Technologies** (NTT) of Tippecanoe, Indiana is joining the project as the torrefaction research and development partner. SERC conducted a competitive selection process involving 10 firms currently operating in the biomass torrefaction space. NTT's proposal stood out due to the readiness of their team's technology and their ability to field mobile torrefaction systems at two different scales within the project's budget and schedule constraints.

NTT will provide a pilot-scale torrefaction unit (see photo, below) for field-testing during the summer of 2015. This unit, which was recently operated alongside two other biomass conversion units in a demonstration sponsored by the Washington Department of Natural Resources, is trailer mounted and will be modified and then delivered to a forest operations site of our choosing near Arcata, CA.



After completion of pilot testing, NTT's team will build a larger torrefaction reactor of the same design and retrofit it into a shipping container. NTT will then ship this containerized unit to Arcata for testing at a forest operations site and provide an operator for testing. Testing of the larger unit is currently scheduled for the summer of 2016. We are looking forward to continuing our biomass conversion research efforts with such a strong industry partner and we are confident that the torrefaction research objectives of the Waste to Wisdom project will be met through collaboration with NTT.

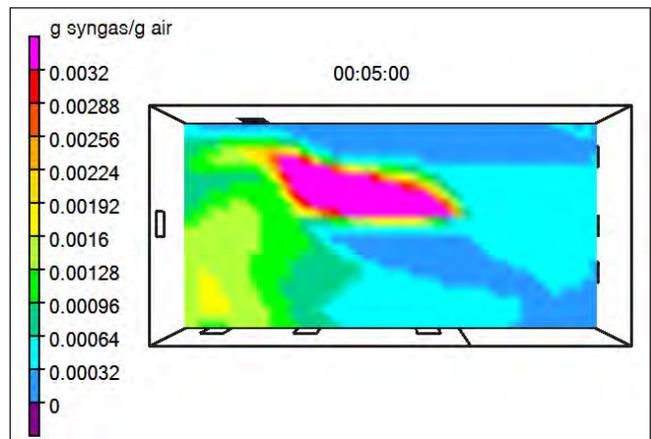
RePower Humboldt: BLR Biomass Facility Ventilation System Design Complete

Andrew Harris

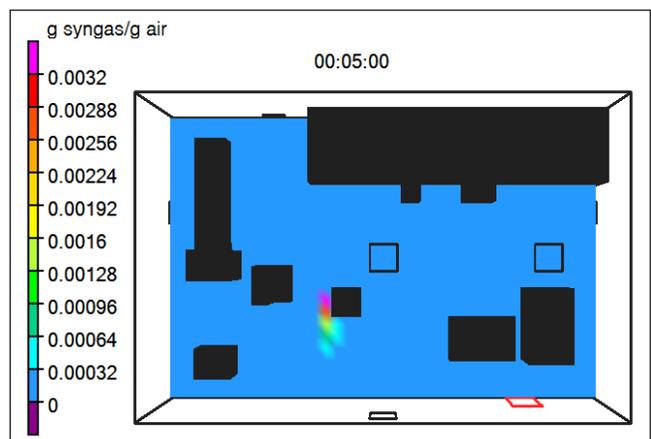
Last summer, the RePower team began evaluating the proposed ventilation system for the **Blue Lake Rancheria** (BLR) biomass energy facility. Each phase of the BLR gasification process involves a dangerous gas. First, biomass is processed into a syngas rich in

hydrogen and carbon monoxide. This syngas is then processed into pure hydrogen and a waste gas rich in carbon monoxide. In normal operation, the syngas and hydrogen are fully contained, and the waste gas is safely burned in a flare. However, an accidental leak in the system could pose an immediate toxic or explosive danger. The ventilation system must give personnel enough time to safely exit, and must clear hazardous gases from the building after the gasifier system shuts down.

To test different system designs, the RePower team used a software package from the **National Institute of Standards and Technology** to model contaminant flow in 3-D. We simulated various leak scenarios and examined how the placement of exhaust fans and intake vents affected the removal of toxic and flammable gases. We were able to improve on the original system design and create a more responsive, and robust system. The final design uses a combination of ceiling fans, wall fans, and floor vents to provide optimum ventilation. Following installation, the ventilation system will undergo a smoke test to validate the model results. Completion of this work will ensure a safe operating environment for the biomass facility.



Models of syngas concentrations five minutes after a leak with the original (top) and final (bottom) ventilation designs. The pink areas are the zones where the concentration is immediately dangerous due to CO toxicity.



(continued on page 6)

RePower Humboldt: Blue Lake Elementary Heat Pump Study Mark Rocheleau

In our last update we mentioned that SERC is working with the [Redwood Coast Energy Authority](#) to install and test heat pump systems at Blue Lake Elementary School. We hope to determine how well such systems work in our local climate and whether or not they can save money as well as reduce greenhouse gas emissions compared to conventional systems.

In July, the project moved out of the planning phase and into hands-on implementation when HVAC contractor Crystal Air of Weaverville installed two Daikin mini-split units at the school. These systems consist of an outdoor compressor unit connected via insulated refrigerant lines to an indoor, wall mounted head (or air handler) which distributes the conditioned air throughout the classroom.

SERC installed a battery of monitoring sensors and data loggers on each of the heat pumps, as well as on the existing natural gas furnaces in two other classrooms. The information collected by the test equipment is being used to determine the amount of heat energy delivered to each of the classrooms as well as the total energy consumed by each of the systems in the process. In the case of the heat pumps, this consists entirely of electricity, while the gas furnaces (as the name implies) rely mostly on natural gas, but also require a moderate amount of electricity for the fan and other electrical components.

Following a shakedown period in which various problems were discovered and rectified, the system is now reliably collecting data around the clock. Preliminary results show that the heat pump systems are consuming less electricity than the conventional furnaces. However, the weather has been so mild up until recently that none of the systems have been used extensively. In addition, the colder it is outside, the more difficult it is for heat pumps to absorb enough energy from the outdoors to heat a room. The true test will come when outdoor temperatures are much lower and heat demand is correspondingly higher.



Contractors install one of the two heat pump units at Blue Lake Elementary school.



Top to bottom: Completed installation of the outdoor unit on top of the covered walkway in front of the classroom. Data loggers with a USB cable for downloading the data to a laptop.



[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 Kevin Fingerman and David Vernon. Research and administrative staff include Nick Bryant, Dave Carter, Greg Chapman, Allison Hansberry, Meg Harper, Andy Harris, Asif Hassan, Malini Kannan, Amit Khare, Ga Rick Lee, Marc Marshall, Carolyn Ortenburger, Janoah Osborne, Kyle Palmer, Greg Pfothenhauer, Tom Quetchenbach, Kristen Radecsky, Mark Rocheleau, Mark Severy, Colin Sheppard and Jim Zoellick. SERC docents are Isabel Contreras, Julia Gomez, Christopher Long, Murielle Manka, Jason McMack, Lorenzo Pagano, and Yaad Rana.

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