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Features

In Every Issue

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HUMBOLDT STATE UNIVERSITY

500kW Solar Array Installed for BLR Microgrid Project

Jake Rada

Construction on the Blue Lake Rancheria (BLR) microgrid began in May, and great progress has been made this summer. While the lasting image of the project will be the 500kW solar array, there was significant preparatory work done above and below ground to make the microgrid functional. This included placing underground conduits for both power and communication lines to connect every aspect of the microgrid. A primary function of these conduits is to combine the 500kW of solar power from the array and the 500kW of stored solar power from the battery bank at a 12kV utility line that ties BLR to the PG&E electrical grid. As of this publication, the following building blocks of this project have been completed:

- all conduit is in place
- all 1,548 solar modules have been installed
- all three concrete pads have been poured to hold equipment for the PV array, the battery bank (BESS), and the point of common coupling (PCC) with PG&E
- all 10 Tesla batteries, as well as the rest of the BESS equipment, are in position and anchored on the pad

SERC graduate student research assistants Pramod Singh (left) and Jake Rada on site at the solar array. *Photo credit Kellie Brown.*

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A Message from the Director

As we move into autumn, I would like to take time to thank the SERC team and our many excellent project partners. We are in the midst of one of the busiest and most productive years in our history. The successes we have had are a result of the hard and good work of our stellar team and our collaborators.

Over the past year we have worked on over 20 projects involving more than 60 collaborators. This work spans four continents, including efforts in Africa (Kenya, Tanzania, Ethiopia, Uganda, and Nigeria), Asia (India, Bangladesh, Pakistan, Myanmar, and China), Europe (UK, Netherlands, and Germany), and North America (USA). While I cannot thank each of our partners by name, several deserve special mention, including the Redwood Coast Energy Authority, the Blue Lake Rancheria, Siemens, Pacific Gas and Electric, Idaho National Laboratory, Lawrence Berkeley National Laboratory, Global LEAP, everyone from the BRDI/Waste to Wisdom team, and colleagues from the World Bank Group's Lighting Global, Lighting Africa, and Lighting Asia programs.

As you can imagine, our team has been very busy. While everyone has pulled their weight and more, special thanks are due in several areas. First, our operations and administrative team, led by Allison Hansberry, has worked tirelessly to keep everything moving forward effectively. I give my sincere gratitude for their efforts and good work. Second, SERC's project managers have managed substantial responsibility with grace and poise. Dave Carter, Jim Zoellick, Jerome Carman, and Meg Harper merit special thanks for carrying heavy project management loads in difficult circumstances. Third, Steve Karp and his team at the Humboldt State University Sponsored Programs Foundation deserve credit for all the support they provide during both the pre- and post-award periods. We all appreciate their efforts; we could not succeed without them. Fourth, the SERC Advisory Board has helped us immensely through input that ranges from strategic guidance to networking support. Their assistance has been invaluable. Fifth, I want to thank everyone on the SERC team who has stepped up and helped with fundraising and proposal writing over the past few months, despite all the other work on their collective plates. While many have contributed, several people in particular have played leadership roles in this push, including Peter Lehman, Kevin Fingerman, Jim Zoellick, Jerome Carman, Meg Harper, Richa Goyal, and Mark Severy. I also want to thank all of the agencies that have supported our work over the past year. Here, the California Energy Commission, International Finance Corporation, World Bank, and U.S. Department of Energy merit special mention for being among our leading funders.

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Northwest California Alternative Fuels Readiness Project

Jerome Carman

With funding from the California Energy Commission under solicitation PON-13-603, the Redwood Coast Energy Authority (RCEA) and SERC began a two-year planning process in the spring of 2014. Key project partners were the Mendocino Council of Governments, the North Coast Unified Air Quality Management District, and the Siskiyou County Economic Development Council (SCEDC). As this project nears completion, we reflect on the accomplishments of the project and next steps for increased regional adoption of low carbon transportation fuels.

Background: "The goal of this project [was] to create an alternative fuel readiness plan through coordinated efforts in the Northwest Region,"[1] which for this project consisted of the counties of Del Norte, Humboldt, Mendocino, Siskiyou, and Trinity. The readiness plan was to "include a strategic assessment of the challenges and opportunities for the adoption of alternative fuels and implementation of targeted outreach programs for fuels."[2]

The project consisted of six main tasks:

- assess the existing status of and potential for future deployment of fuels
- analyze existing and potential incentives structures
- identify strategies for increased procurement and commercialization of fuels
- review existing training materials targeted to relevant stakeholders and identify needs and barriers
- develop materials and strategies that communicate the benefits of low carbon fuels to targeted stakeholder groups
- create a complete, comprehensive, and detailed readiness plan for the region.

Accomplishments and Results: As reported in the Spring 2015 newsletter, SERC addressed the first task through the development of a simulation model that explores marginal abatement cost curves in order to guide regional investment in low carbon fuels. The model used the statewide Low Carbon Fuel Standard (LCFS) target of a 10% reduction in transportation fuel carbon intensity by 2020 (see Figure on page 5). The key conclusions of this analysis are

- Electric vehicles currently present the least incremental cost across commercially available fuels and technologies, in terms of infrastructure capital cost, vehicle capital cost, and vehicle cost of ownership.
- Due to market limitations there is no single "silver bullet"

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Project Updates

Schatz Solar Hydrogen Project: Photovoltaic Module Testing Charles Chamberlin

SERC volunteer Andre Bernal (below, left) and graduate student research assistant Jake Rada (below, right) measure the current and voltage curve of a photovoltaic module that has completed 26 years of service in the Schatz Solar Hydrogen Project. Each of the 192 modules in the project has been tested in 1990, 2001, 2010, and now again in 2016. We'll provide the results of our latest testing in a future newsletter.

SERC Completes Energy Planning Project for the Trinidad Rancheria Mark Rocheleau

Readers of this newsletter may recall that the Summer 2015 issue contained a short piece about an energy planning project we conducted for the Cher-Ae Heights Indian Community of the Trinidad Rancheria. Funded by a grant from The Bureau of Indian Affairs Energy and Mineral Development Program, this multi-faceted project had the overall goal of reducing the tribe's energy consumption, costs, and greenhouse gas (GHG) emissions through the implementation of energy efficiency measures and, possibly, producing renewable energy locally.

The project has since been completed and there is much to report.

Use Assessment

The initial phase of the project entailed a comprehensive assessment of recent energy use for the Rancheria's multiple commercial facilities including the Cher-Ae-Heights Casino, the Seascape Restaurant, and tribal offices. Available information pertaining to the consumption of electricity, propane, diesel fuel, and gasoline, as well as the equipment involved, was cataloged. CasinoGreen, a PG&E subcontractor specializing in retrofits of Native American owned casinos, was responsible for examining the casino, while Redwood Coast Energy Authority (RCEA) covered the remaining facilities. RCEA also completed a comprehensive GHG inventory utilizing an Excel spreadsheet tool they developed in-house.

Results show electricity use in all tribal facilities accounts for 77% of energy costs and over 60% of all GHG emissions. Unsurprisingly, the casino is responsible for over 75% of total energy costs and more than 80% of all GHG emissions, but it is interesting to note that the Seascape Restaurant comes in second at 10% of costs and 9% of GHG.

Efficiency Assessment

Lighting accounts for a substantial portion of all electrical consumption, particularly for the casino, which operates around the clock. As lighting technology has changed considerably in recent years, the energy efficiency of available products greatly exceeds that of the equipment currently in use by the tribe. As a result there are great savings to be had by retrofitting their facilities.

CasinoGreen provided an extensive list of lighting upgrades for the casino, primarily focused on the replacement of existing equipment with new LED lamp, ballast and fixture packages. In total, the changes they suggest could save the tribe an estimated $21,000/year. Available rebates will defray the upfront installation costs considerably while the balance can be financed by PG&E's Energy Efficiency Retrofit Loan Program. This zero-interest On-Bill Financing program for energy retrofits is paid off via normal monthly payments that credit the money saved due to the new equipment toward the loan balance, which is expected to be paid off in about four years.

In the early stages of the project, RCEA determined that the tribe could save more than $3,000/year by simply changing the Seascape's PG&E account to a different rate. This was done with alacrity. Further recommendations for lighting and refrigeration efficiency upgrades could save an additional $2,600 annually for the restaurant. As with the casino, installation costs can be covered by rebates and On-Bill Financing. These improvements should pay for themselves in less than four years.

RCEA recommendations for the remaining facilities consist primarily of upgrading interior fluorescent tube lighting systems to LED technology, with some exterior lighting upgrades as well. These changes should have a payback period of just under five years.

Renewables

Following SERC's examination of the potential for various on-site renewable energy resources, the project team concluded that solar electricity is the most economically viable technology for the tribe to pursue. We recommended three suitable sites for roof top installation: the Trinidad Pier bathroom and water treatment plant, the Trinidad Pier Guest House, and the tribal office building. These sites could accommodate systems of 8.2kW, 2.1kW, and 10.5kW respectively. As the Rancheria has sovereign nation status, they do not pay taxes, which in turn means that

they do not qualify for the 30% tax credit or accelerated depreciation benefits available to those in the private sector. As a result, payback periods are noticeably longer (9 - 11 years) than for systems installed by private businesses with substantial tax obligations. Nevertheless, an investment in this technology would pay for itself over a reasonable time frame, and the electrical energy generated by these systems would continue to reduce the Rancheria's dependence on PG&E long into the future.

Greenhouse Gases

If all of the recommendations discussed in this article were to be implemented, the tribe could reduce its GHG emissions by 65.2 metric tons of carbon dioxide equivalent per year. This amounts to a nearly 10% reduction of the tribe's estimated GHG emissions associated with current electricity usage levels.

SERC would like to thank the Trinidad Rancheria for the chance to perform this energy assessment work. We are pleased to have found numerous opportunities for the tribe to reduce energy costs, decrease GHG emissions, and increase energy security. We look forward to supporting the tribe in their future efforts to meet their sustainable energy goals.

UNCDF Energy Ladder Research Richa Goyal

The first and second phases of the Energy Ladder Research project, a yearlong study in rural Uganda funded by the United Nations Capitol Development Fund CleanStart Programme, are nearly complete. The study aims to investigate end-user patterns of adoption of off-grid solar energy products in one district each in the central and the eastern regions of Uganda. Our first project announcement was published in the Winter/Spring 2016 SERC newsletter.

In the first phase of the project, Arne Jacobson and I organized a stakeholder workshop in Kampala, and visited and built familiarity with the districts under this study. During this phase, we also pilot tested the household phone survey and mapped the off-grid solar product distribution chain in these districts.

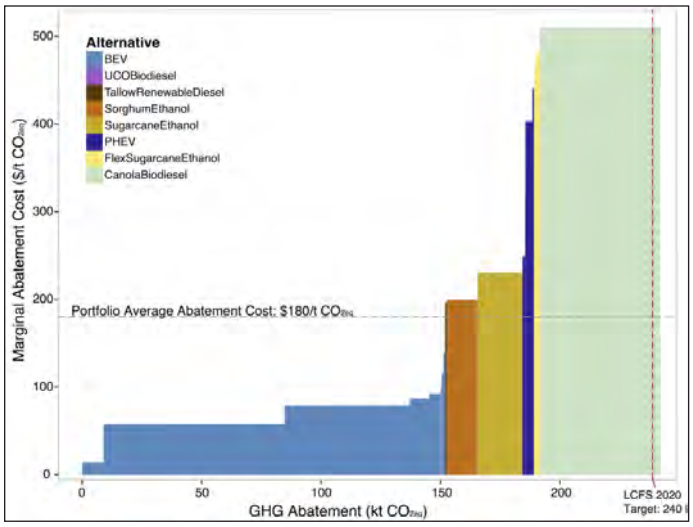
In the second phase of the project, I trained the survey team from the Center for Integrated Research and Community Development Uganda (CIRCODU), a Uganda-based organization specializing in field research on topics such as off-grid solar energy, the context and role of research, business models of data partners, and best practices for conducting interviews. During this phase, the CIRCODU team and I also initiated and completed the baseline surveys, which comprised short telephone interviews with 614 off-grid solar product buyers and longer face-to-face interviews with 117 of these respondents. This strategy helped save cost associated with implementing face-to-face interviews with a wider sample and at the same time provided the research depth that comes with in-person interviews, albeit for a smaller sub-sample. The phone surveys were used to gather critical data required for the study and the face-to-face surveys for verifying some of the responses received from phone surveys and for diving deeper into specific topics.

In the next stages of the project, I will prepare baseline survey data for analysis, consolidate early insights from the project based on the work so far, and prepare end-line surveys due to be implemented in January and February of 2017.

Top: Surveyors from CIRCODU interview an off-grid solar product customer, Luwero, Uganda. Bottom: Example of an electronics shop that also stocks solar components, Luwero, Uganda.

fuel. Regional investment in a variety of low carbon fuels is needed to meet the 2020 LCFS target.

- Portfolio-wide average marginal cost of carbon abatement (see below) is projected to be around $200 per metric ton of carbon dioxide equivalent, and could very well exceed this.



The results of this simulation model were used to develop regional estimates of the direct impact to the transportation sector should model results be fully implemented. These estimates show that 17% of passenger vehicles and 2.7% of all other on-road vehicles may be impacted, resulting in a 6% increase in electricity consumption and a displacement of 10% of total gallons of gasoline and diesel currently consumed in the region. Furthermore, over 300 public electric vehicle parking stalls may be needed along with 19 new or retrofitted liquid fueling stations representing 9% of existing stations in the region. The projected incremental societal cost over the five-year period between 2015 and 2020 is $43 million (in 2015 dollars), which averages to $1,600 per vehicle across all fuel and vehicle types modeled.

In parallel to the above modeling effort, the project team formed three working groups that informed the planning process: a strategic planning working group, a fuel distributor working group, and a training materials working group. The working groups helped identify barriers and potential solutions to increased low carbon fuel adoption as well as guided the structure of the readiness plan. The input from these stakeholders, along with an extensive literature review, resulted in the identification of 22 specific barriers and 69 potential actions to address these barriers.

In addition, project partners developed outreach materials to be used to engage with and inform a wide array of stakeholder groups, focusing mainly on local government entities and fleet managers. Numerous outreach efforts were also conducted, including extensive engagement with public and private fleet managers and local government agencies.

Readiness Plan and Next Steps: The above efforts have been synthesized into a detailed regional readiness plan which is now available. The primary audience is local government, but the plan contains useful information for fuel distributors and fleet managers and contains recommendations for action across all stakeholder groups including state policy makers.

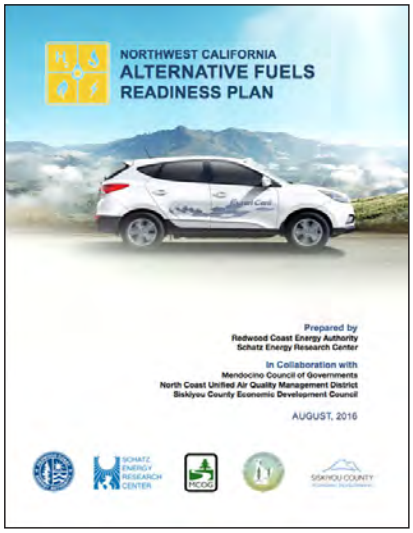
Project partners also identified the Department of Energy Clean Cities program as a key next step that could continue the development and implementation of the readiness plan. To this end the project team held a strategic networking event in February in Eureka that was simulcast to Redding and Ukiah, California. The goals of the event were twofold:

- bring local government stakeholders up to speed on state and local efforts to accelerate the adoption of low carbon transportation fuels and vehicles

- explain the Clean Cities program, outline the potential benefits of this program for the region, and pursue stakeholder interest and/or commitments to the formation of a Clean Cities Coalition.

A total of 20 different stakeholder agencies were represented at the event across seven counties, two CalTrans Districts, and two Assembly Districts. All stakeholder representatives expressed positive interest in the development of a Clean Cities Coalition in the North State region and found the event informative. Commitments to further action were made regarding participation in future events to solidify details and next steps. Two follow-up meetings were held in May and June with a sub-group of participants during which co-coordinator commitments were confirmed from SCEDC and RCEA. A Clean Cities Coalition application to the DOE is currently in development and is expected to move forward.

Conclusion: It is clear the proposed LCFS target is not realistic for the region in the near future given the level of investment and action required over such a short time frame. However, the readiness plan provides a useful guidepost for regional stakeholders, and quantifiable and actionable steps that can be taken now and well past the LCFS target date of 2020. In addition, the successful formation of a Clean Cities Coalition in the region is expected to increase the impact of this project and will hopefully lead to future funding and action in the region.



[1] California Energy Commission Agreement Number ARV-13-012.
[2] Ibid

Microgrid Project (continued from page 1)

- PCC switchgear is in place and anchored

There is still much to be done before the microgrid can begin to provide a renewable power generation source that is resilient and reliable. Now that the equipment and hardware are in place, the process of installing the software that is integral to making the off-grid islanding aspect of the microgrid possible will begin. The project is scheduled to be completed by early November.

Pramod Singh and I, both graduate student research assistants, represented SERC and the BLR Microgrid project at this summer's InterSolar/ASES Conference and Expo in San Francisco. We gave a brief presentation outlining the design, goals, and progress made so far on the BLR microgrid, and we attended other presentations and panels dedicated to the solar energy sector. It was encouraging to learn that many conference attendees see microgrids as playing a critical role in the future of solar energy. SERC's experience with the BLR microgrid will prove to be a fruitful venture as microgrids become more popular and affordable.

Tesla battery bank with the solar array in the background.

Message from the Director (continued from page 2)

I will close with some staff transitions. First, I am pleased to welcome our new faculty members; Peter Alstone and Liza Boyle joined us in August. Peter has a joint appointment between SERC and the Environmental Resources Engineering (ERE) Department, while Liza is a Faculty Research Associate at SERC and a member of the ERE Department. Both are already engaged in activities at SERC, and we look forward to much more of their involvement going forward. I am also pleased to welcome Scott Toyama, Jimento Aikhuele, and Steve Shoemaker to the SERC team. Scott joined in May as a full-time engineering technician in our off-grid solar laboratory. Jimento and Steve are incoming graduate students in the Energy Technology and Policy (ETaP) master's program. Jimento is this year's recipient of the Schatz Energy Fellowship, while Steve is the first recipient of the Blue Lake Rancheria Fellowship for Clean Energy Studies. It is great to have them both on board (and thank you again to the Blue Lake Rancheria Tribe for establishing the fellowship).

Last, but certainly not least, I want to thank people who have moved on from SERC to other endeavors. These include Malini Kannan, Janoah Osborne, Ga Rick Lee, Greg Pfotenhauer, and Lukas Kennedy; they each made great contributions over the past few years to SERC's work related to off-grid solar, clean transportation, and/or biomass energy. I am also grateful to Asif Hassan, Jayati Thakor, Steve Harrison, Emily Klee, and Rich Williams, all of whom worked for us as students, for their efforts on projects related to off-grid energy access and biomass energy. Richa Goyal, who has been with us at SERC as a visiting scholar for the past year and a half, has moved back to India. Fortunately for us, she will continue to work with us as a consultant going forward. Finally, a very special thank you is due to Mark Rocheleau, who retired from SERC in June after 24 years of dedicated service. All of these good people are greatly missed, but we are excited about all the good things that they are doing out in the world.

Goodbye until next time.

SERC's mission 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.

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