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UC SOLAR

Illuminating the Future of
Renewable Technology

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UC Solar



> There are more than **2,100** solar companies at work throughout California, employing **54,700** people.

The multicampus research institute helps steer renewable energy research and education

BY JOEL PATENAUDE

> **ABOUT THE AUTHOR:** Joel Patenaude is sun deprived several months a year in Madison, Wis., where he's the managing editor of Silent Sports Magazine. He has many years of professional newspaper experience, covering state and local politics, Native American treaty issues, the environment and a wide array of other topics.



UC SOLAR RESEARCH LABS TAKE ADVANTAGE OF CALIFORNIA'S PLENTIFUL SUNLIGHT.

B

ill Guiney is strongly considering assembling his company's solar energy collectors in Merced County.

Although based in Florida — which has no shortage of sunlight — the Artic Solar CEO is drawn to California's San Joaquin Valley and the solar energy brain trust centered at UC Merced.

"It's all integrated there: private and public partners in the solar industry. I would be close to the R&D. And utilizing

the graduate student researchers there is a good possibility," said Guiney, former manager of renewable energy programs for the multinational technology company Johnson Controls.

The solar industry is adding jobs 10 times faster than the overall economy, driving policies and attracting millions of dollars in investment from major corporations. According to news reports in Mother Jones magazine, the boom isn't slowing, either. Data from market analysis firm GTM Research shows 2014 was solar's biggest year ever, with 30 percent more photovoltaic installations installed than in 2013, the magazine reported.

And when it comes to leading solar technology, people like Guiney are increasingly looking to the University of California Advanced Solar Technologies Institute (UC Solar), a nine-campus effort led by Professor Roland Winston at UC Merced.

UC Solar recently won the largest UC Multicampus Research Programs and Initiatives (MRPI) grant of those awarded — \$2.7 million — and is poised to lead the state into the future of solar energy research and development, as well as public policy surrounding it.

Winston's research team tested Guiney's commercial design of Winston's External Concentrating Parabolic Collector (XCPC) panel, which is capable of generating thermal temperatures of nearly 400 degrees Fahrenheit using nonimaging optics technology.

UC Solar, Guiney said, "has been very helpful. They did the initial testing of this technology — rock-solid testing, not the 'as seen on TV' kind."

'A SHOT IN THE ARM'

What started in 2010 as an initiative between UC Merced, Berkeley and Santa Barbara now involves nine of the 10 UC campuses. That Merced, the university system's youngest campus, serves as the headquarters for UC Solar, is recognition of director Winston's stature in the field of solar research.

Winston is considered the father of nonimaging optics, and his invention, the compound parabolic collector (CPC), is sometimes known as the "Winston solar collector."

Winston's attention is focused on developing highly efficient and affordable solutions to real problems.

"We're out there globally developing the solar technology the world will need 20 to 50 years from now," Winston said.

UC Solar is also addressing needs in far corners of the world. That's why Winston sent one of his graduate students to Mongolia to set up an XCPC demonstration project.

The young man, who hadn't previously left California, "went to the coldest inhabited place on Earth in January; where the burning of coal has so affected the air quality that it's like breathing smoke," Winston said.

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– PROFESSOR ROLAND WINSTON
UC SOLAR DIRECTOR





PROFESSOR ROLAND WINSTON AND HIS STUDENTS
WORK ON A VARIETY OF PROJECTS INVOLVING
SOLAR COLLECTORS LARGE AND SMALL.

- There are more than **17,500 megawatts of cumulative electric solar capacity** operating in the U.S. — enough to power more than **3.5 million average American homes**.



The experiment at Mongolia National University has been so successful, the professor said, a solar-heated greenhouse might be built to provide locals with otherwise hard-to-get fresh produce. Demonstrations of the technology are also underway in India, China and Dubai.

Guiney said this solar thermal technology has the potential to address the vast unmet commercial needs that lie between environmentally conscious homeowners, cutting their utility bills with solar panels on their roofs, and large power companies facing government mandates to provide customers with renewable sources of electricity.

The high temperatures XCPCs produce at 50 percent thermal efficiency can be harnessed to run large air conditioning systems in commercial buildings, desalinate ocean water and generate electrical power, all functions that are in high demand throughout California.

“This technology is a real shot in the arm for the solar industry. With this, UC Solar can achieve a rebuilding of the solar thermal industry, and reduce emissions,” Guiney said.

GATHERING INTEREST

Flexible organic solar cells are in development at UC Davis, under the direction of Professor Pieter Stroeve. He said this technology, resembling flexible high-gloss paper, boasts 12 to 15 percent efficiency in converting the sun’s rays to electricity. That’s a commercially viable level, assuming the solar cells can be mass produced.

“They can be used on complex surfaces like that of a car, so that its battery can store the energy captured,” he said. “The cost will eventually be very cheap.

But right now, the solar cells need to be synthesized in a lab before they can be scaled up for manufacturing.”

UC Davis joined UC Solar a couple years after it was founded, and that association has increased the visibility of research being conducted on the campus and through the California Solar Energy Collaborative (CSEC), which is part of the California Renewable Energy Center (CREC), Stroeve said.

Being a UC Solar member now means getting a share of the new MRPI grant, nearly 80 percent of which will be spent in direct support of graduate research and undergraduate education in the solar sciences.

“That’s important because it brings together researchers from other departments and outside the university system,” Stroeve said. “It helps get people all the more interested in participating.”

Each UC Solar member campus will attempt to leverage the intra-university system investment in its efforts to secure federal funds and private-sector projects.



FINDING REAL ANSWERS

Those in the business of selling, installing and maintaining the end products do come to researchers with problems in need of solutions.

“For example, there’s a reason you don’t see solar farms on the coast,” said Professor Michael Isaacson, UC Solar’s co-director at UC Santa Cruz. “It’s because birds poop on the panels, which cuts into their efficiency. Dust from farmlands settles on them, too. It sounds mundane, but it’s a serious problem. So we’ve been asked to develop self-cleaning solar panels.”

UC Riverside has a campuswide and city-involved Sustainable Integrated Grid Initiative through which a variety of emerging solar energy technologies can be tested. This “microgrid” includes charging stations for electric vehicles and car parks covered by solar panels.

And engineers, economists and social scientists are on board at UC Santa Cruz to study how industry can reassure the public that renewable energy can be reliable, affordable and a means to local energy independence.

But energy derived from the sun and wind is intermittent, meaning it isn’t generated when the sun’s not out and the air is still, “which makes people nervous about integrating renewables in the energy grid,” Isaacson said.

“We’re trying to devise strategies and devices that can sense how we’re using electricity and help us can save energy,” he said. “From an educational point of view, we want to equip students who go into public policy with a technical background.”

SEEING THE FUTURE

Isaacson said his students have looked to Germany and Denmark, where the governments subsidize investment in renewable with ambitious goals. Denmark, for example, hopes to be 100 percent free of fossil fuels by 2030.

In contrast, California is requiring its electric service providers to obtain 33 percent of their energy from renewable sources by 2020 — “one of the most ambitious renewable energy standards in the country,” according to UC Solar’s MRPI grant renewal proposal.

The UC Merced campus is well on its way. Seventy-five percent of its energy needs will be met by renewables by the end of 2016 and 100 percent shortly thereafter, making it the first campus in the world with that distinction.

To help reach California’s target, the state will invest \$900 million collected from rate payers on clean energy research, development and demonstration projects via the Electric Program Investment Charge (EPIC). This could include putting money into existing California-based research centers, such as UC Solar.

“We’re keeping close tabs on EPIC,” Winston said. “I’m all for public funding of research. Any amount can help, if spent wisely.”



THE SCIENCE AND ENGINEERING BUILDING 2 FEATURES A SOLAR INSTALLATION THAT HELPS POWER THE BUILDING.

- › Average installed residential and commercial photovoltaic system prices in California dropped by 3 percent in 2014. National prices have also dropped steadily — 49 percent since 2010.

