

The Friday morning crew. Putnam, in a brown baseball cap, is seated in the foreground. Kelzenberg is standing second from right, wearing a cowboy hat.



STUDENTS GO SOLAR

Even as the Caltech administration launches big-ticket sustainability projects, there are grassroots endeavors as well. The roof of the Watson Laboratories of Applied Physics sprouted a 72-panel solar array the week before Thanksgiving, thanks to the newly formed Caltech Student Solar Initiative (CSSI). About 80 undergrads, grad students, and postdocs laid out solar panels, bolted them to their supports, wired them up, and schlepped cinder blocks between November 19 and 21—“We had as many people as we could manage,” says Morgan Putnam (MS '08), the project leader.

Putnam and Michael Kelzenberg (MS '06), the lead project engineer, are keenly interested in solar power. When not clambering around on rooftops, they're grad students in the lab of Harry Atwater, the Hughes Professor and professor of applied physics and materials science, and work on developing silicon microwires that could be used as solar cells. (The Atwater group, coincidentally, lives in the Watson Labs.)

The project was student-designed and executed as much as possible. Kelzenberg handled the array layout and wiring, while Putnam worked out the details of the cinderblock ballast-

ing system that keeps the arrays in place without having to drill holes in the roof. Says Kelzenberg, “Students contacted suppliers, designed the array, and [junior] Daryl Coleman filed the application for the rebate” with Pasadena Water & Power that will pay back about half of the \$118,000 materials and installation cost.

Grad student Amy Hofmann (MS '08) organized and submitted the CSSI's application to the Moore-Hufstедler Fund for Student Life, which will cover another \$32,000 of the initial installation costs. Says Putnam, “This was a large task, and Amy did a great job of assembling information from a large number of sources to produce a final product.” Caltech's Facilities Department will cover the rest of the cost, while the Graduate Student Council chipped in \$1,000 to feed the volunteers during the installation.

Facilities, particularly Mike Anchondo, the head of Caltech's electrical shop, donated a lot of help and expertise, says Kelzenberg. For example, Narinder “Nick” Grewal, the electrical engineer for physical plant, double-checked the rebate application. Adds Putnam, “CSSI offers its sincere thanks for the generous

support of Caltech Facilities. Nick Grewal and Mike Anchondo helped field electrical questions. Don Thomas helped with roofing concerns. Kalman ‘Lee’ Benuska handled seismic and wind-loading concerns. Bill Irwin and Kenneth Hargreaves helped with long-term planning and project planning. Most importantly, Jim Cowell [Associate VP, Facilities] and John Onderdonk [Sustainability Program manager] fielded questions across a spectrum of topics. Their offices were always open.”

“This is the only Caltech-owned solar array on campus,” says Kelzenberg. “There are larger, more expensive arrays, such as the one on the roof of the Holliston parking structure, but Caltech actually leases these roof areas to outside companies, who own the solar panels. Caltech then buys the power. Here, Caltech owns the panels, and all the power they produce.”


The array will put out an estimated 13.7 kilowatts at peak—that is, at noon on a sunny day. Year round, this is expected to amount to about 23,000 kilowatt-hours of juice. The CSSI plans to sell this green energy in the form of 150 Renewable Energy Credits for 150 kilowatts each—



Atwater postdocs Dierdre O'Carroll and Marina Leite install the support structure on the back of a solar panel.

“enough to run your laptop for one year,” says Putnam—which students can buy for \$20. The proceeds will go into a student sustainability account to fund future projects.

Including the Holliston parking structure array, which went online November 4, Caltech Facilities plans to install 1.4 megawatts of solar power over the next 12 months. These arrays will be atop the two Wilson Avenue parking structures, the Braun Athletic Center, the Infrared Processing and Analysis Center, Baxter Hall of the Humanities and Social Sciences, and the new Cahill Center for Astronomy and Astrophysics.

The CSSI hopes to add to the total, using the roofs of smaller, more oddly shaped buildings. Says Putnam, “These small projects are very labor-intensive, and therefore amenable to student activity. And with the group we have now trained, we could do a lot more very easily.” Kelzenberg agrees, “We could do it again with half of the effort, if we get more funding. There are lots of smaller roofs all over campus that students could do this way.” —DS 

NEW ENERGY FOR MECHANICAL ENGINEERING

Author Tom Friedman leveled his gaze at a lunchtime assemblage of Caltech faculty, students, and friends and threw down the gauntlet: “Only Caltechs are going to get us out of this problem,” he said. He was talking about three problems, really, that he views as one giant Gordian knot: climate change, the global economic crisis, and America’s dented world leadership. During his most recent campus visit, the writer of the best sellers *Hot, Flat, and Crowded* and *The World Is Flat*, not to mention innumerable “most e-mailed” articles in the *New York Times*, joined Argyros Professor and professor of chemistry Nate Lewis (BS, MS '77)—a principal investigator in the Caltech Center for Sustainable Energy Research (CCSER)—in a conversation about these problems. Friedman commented that America’s research universities could help lead the way out of all three with one bold stroke. He’s calling the solution ET—not the alien

darling of the '80s, but energy technology, the challenge of the Aughts. “The motto for America,” he quipped, “should be ‘Invent, Baby, Invent.’”

Invent we will. Caltech already boasts programs like CCSER, which focuses on solar energy, and the Linde Center for Global Environmental Science. These have now been joined by an Energy Engineering Initiative, which was funded as part of a \$10 million gift from the Gates Frontiers Fund this September that established the Charles C. Gates Center for Mechanical Engineering.

“One is tempted to say that energy is *the* technological challenge facing engineering,” says Kaushik Bhatnagary, professor of mechanics and materials science and executive officer for mechanical engineering. “The scale and magnitude of the numbers involved make the problem very hard to grapple with—the amount of energy used, the time horizons on which investments are made. Decisions we’re making today will tie our hands in the future. The challenges we’re facing are such that we have to invest in completely new technologies, but at the same time, we have to address



The solar array atop the Holliston parking structure, installed and operated by El Solutions, will crank out some 320,000 kilowatt-hours (kWh) per year, earning a \$0.632/kWh rebate from Pasadena Water & Power—and it provides shaded rooftop parking.