



Award Category

Innovative Energy Generation

Green Features

System supplies roughly 20% of the campus's base electrical demand

Clean energy generation produces no particulate or greenhouse gas emissions

Long-term fixed electricity rate is below-market price

Security lighting uses efficient T-5 fluorescent lamps

Four educational kiosks display real-time power production data

Annual Energy Savings

1.525 million kWh

Size

3872 panels cover 677 parking spaces, totaling 1.1 megawatts

Cost

\$11.9 million total cost

\$4.75 million cost to university

Completion Date

November 2007

Fresno State Solar Photovoltaic Shaded Canopies

Fresno State transformed a barren parking lot into a large-scale renewable energy generation site by installing ten parking canopies crowned with 5.5 acres of photovoltaic panels. The 1.1 megawatt installation will save over \$13 million in its 30-year lifespan and prevent 950 metric tons of greenhouse gas emissions.

When the CSU Office of the Chancellor issued Executive Order 987 in 2006, Fresno State took notice. The order calls for every CSU campus to procure 20 percent of its electricity from renewable sources by 2010, and to install appropriate technologies on-site to help meet the mandate. In response to this challenge, Fresno State designed a ten-canopy parking structure and topped it with five and a half acres of photovoltaic panels. The 1.1 megawatt system is so large that it alone satisfies Executive Order 987, and also ranks as the largest project of its kind at any American university.

Fresno State is well-suited for photovoltaics, with substantial amounts of sunlight falling on the campus for much of the year. To take advantage of the favorable climate the university first needed to identify sites large enough to accommodate a one-megawatt installation. A survey of campus buildings revealed that most had too many equipment penetrations for traditional rooftop installations to be feasible. Determined to use solar power to meet Executive Order 987, the university began considering a less common place for its system—a parking lot.

Fresno State was chosen from over 400 applicants to receive a PG&E Self-Generation Incentive grant. The campus won \$2.8 million, the maximum amount awarded to projects rated at one megawatt.

Photovoltaic-covered parking canopies are a creative way to convert barren, hot asphalt into a dual-function landscape. With this type of installation, an area already developed for parking can generate significant amounts of electricity while providing cooler, shaded stalls for cars. Additionally, solar canopies can generate a revenue stream by creating an opportunity to collect premium rates for covered stalls.

Looking at different lots for solar obstructions and size, Fresno State found that Parking Lot V was an ideal place to site solar canopies. Its central location made it a strategic spot to offer covered stalls for a premium fee because demand for such spaces was likely to be high. The prominent location would also enable the university to showcase the benefits of renewable energy to visitors and the campus community.



The solar canopies provide the only shaded parking on campus. Photo: Randy Vaughn-Dotta.

With a feasible location identified, the university set out to explore potential arrangements for system financing and ownership. The campus found that it would be crucial to partner with a third party investor that could take advantage of a 30 percent tax credit offered through state and federal renewable energy programs. Under this financing strategy the company would pass a portion of the cost savings on to the university. It would then own and maintain the panels for a set period of time and sell the electricity produced back to the university at a below-market price.

Fresno State selected MMA Renewable Ventures to be the project financier. Under a power purchase agreement negotiated with MMA, Fresno State will pay \$0.16 per kilowatt-hour with a two percent annual escalation factor for the next twenty years. This rate

BEST PRACTICES

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Team

Energy Services
Company & Design/
Build Performance
Contractor: Chevron
Energy Solutions

Third Party Investor:
MMA Renewable
Ventures

Photovoltaic
Manufacturer:
SCHOTT Solar Inc.

Electrical Contractor:
Sun Electric, LP

More Information

www.chevronenergy.com/news_room

is currently \$0.07 below electricity provided by PG&E. At the end of twenty years, ownership of the panels transfers to Fresno State and the campus will enjoy the electricity produced over the remainder of the system's lifetime virtually for free.

Fresno State selected Chevron Energy Solutions to act as the Energy Services Company and provide design/build services for the canopies and other parking lot upgrades. Chevron ES and the university worked collaboratively at every phase to engineer canopy structures that fulfilled the campus's aesthetic and economic requirements.



A corrugated aluminum covering protects cars from nesting pigeons. Photo: Randy Vaughn-Dotta.

After considering many different configurations and materials, the team decided that a double-cantilevered tubular steel canopy design would maximize the number of shaded parking stalls per lane, minimize maintenance, and provide a clean and streamlined aesthetic. The structures are designed with a minimal two degree fixed tilt to facilitate self-cleaning. The canopies are also fitted with corrugated aluminum underneath to prevent birds from nesting, an important thing to consider when offering visitors protected parking stalls.

In addition to optimizing the canopy design, Chevron ES collaborated with the campus to evaluate photovoltaic panels. The team selected high-performance polycrystalline

panels manufactured by SCHOTT Solar. Each 2.4 square meter module generates up to 320 watts at its peak output. The panels have the largest surface area of any standard-sized module on the market, which reduces the number of interconnects and structural members needed. The SCHOTT modules also have a bypass diode located every 18 solar cells that minimizes power loss and prevents overheating, making the system highly reliable.

The predictability of long-term fixed energy prices will help the campus manage its utility expenditures and hedge against future rate increases for utility-provided power.

Fresno State has expanded the impact of the solar canopies project by turning it into an educational resource for the campus. Four interactive kiosks, two of which are located in the parking lot and two in nearby buildings, provide real-time data for the system's current, daily, monthly and lifetime energy production. The kiosks help visitors draw connections between electricity and its environmental impacts by providing figures on the amount of greenhouse gas emissions the project prevents through photovoltaic energy generation.

To build on the success of the solar canopies project, Fresno State is designing a second one-megawatt photovoltaic installation. This array will sit atop a new animal shelter and feed storage structure at the campus farm.

LESSONS LEARNED

Fresno State strongly advises campuses to build a performance clause into all power purchase agreements. With this language in the service contract a university is obligated to pay only for electricity the photovoltaic system produces. Customers that do not include a performance clause will be billed for a set quantity of energy regardless of actual electricity generation levels.

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