

PARKING INDUSTRY KEY TO SOLAR POWER'S GROWTH

Innovative Systems Installed Over Parking Lots and Garages

By David Oxtoby

Solar power systems, which generate energy from sunlight, are rapidly emerging as a practical and clean alternative to other sources of power and a good way to reduce greenhouse gas emissions.

While the total capacity of solar power systems installed in the U.S. still remains small, especially when compared to some other countries such as Germany and Japan, there has been a significant jump in new installations in the past few years and the industry now looks poised to take off.

Based on some recent projects described below, there are also clear signs that the parking industry is about to start playing an important role in solar power's growth. Owners and operators of parking facilities are beginning to find their locations in demand as potential sites for solar

installations, and they are being approached with innovative third-party financing opportunities.

Depending on the location, the opportunity exists to reduce current energy expenses or lock in future ones, eliminating uncertainty and making business planning easier. Beyond its economic benefits, solar power offers organizations the opportunity to do something visible to demonstrate environmental leadership, setting a positive example for suppliers, customers, partners and other stakeholders.



Several Technologies

The term "solar power" encompasses several technologies, including different ways to make electricity, steam or hot water from the sunshine that reaches the earth's surface. One of the most proven and reliable technologies is called photovoltaics, or PV. PV systems normally take the form of blue or black glass panels measuring about three feet by five feet, mounted in such a way that they are perpendicular to the sun's rays. The active material inside these PV panels is either thin wafers of crystalline silicon or a number of alternate materials which convert sunlight directly into electricity. The systems are solid state and very durable, with manufacturers' warranties normally extending 25 years.

PV systems trace their origins to the late 1950s, when NASA developed the first small units to power early satellites. In the latter half of the century, their use grew more widespread, normally in off-grid systems with battery backup, for remote locations or portable power. Systems were still expensive, and from a cost perspective they made sense only if the alternative, such as running new power lines, was even more expensive.

In recent years the situation has changed. Equipment costs have fallen because of new manufacturing efficiencies and increased volumes. Electricity rates have risen, and different levels of government have introduced new incentives. Taken together, these changes now make solar PV a practical option for larger, rooftop or ground-mounted systems even when the traditional power grid is an option. These new systems are grid-connected, and don't use any battery systems to store electricity.

Rapid Growth

The numbers speak for themselves. Across the U.S., the annual capacity of new solar installations has risen at a compound annual rate more of than 40 percent over the past five years. New grid-connected photovoltaic (PV) installations rose from 106 megawatts (MW) in 2006 to 148 MW in 2007. Accurate 2008 figures are not available yet, but the total was higher still.

Equipment costs continue to fall, and new ways to finance the systems are emerging. Given what is widely expected to be strong support by the Obama administration, plus growing support

among a number of state governments, solar power may soon become a significant contributor to the country's overall mix of energy sources.

At present the most economic use of solar power is in situations where the power can be used as a substitute for retail grid electricity, fully displacing the delivered cost of traditional, centrally-generated power. Customers who face tariffs with higher prices for peak daytime use, and those who are allowed to use "net metering" to feed any excess solar power back into the grid when their own load is light, reducing their monthly bill, are the ones who normally can benefit the most. In this way solar power differs from wind power, which is normally generated in larger quantities in locations far away from retail loads, and sold at wholesale utility prices.

Space Needed

As the use of solar power becomes more widespread, one thing that has become clear is that the systems require space, and lots of it. Panel efficiency – the measure of how much electricity can be made from a given amount of sunshine – is rising, but there are laws of physics that limit how much improvement is even possible.

Even with state-of-the-art systems, most buildings simply do not have enough space on their rooftops to generate the power needed to fully offset their electric loads. Using rooftops alone, only large, single-story buildings such as warehouses, with light electric loads, have the potential to be self-sufficient.

Most industrial, commercial and institutional electricity users can only offset part of their electricity use with solar power, even if they commit all of their rooftop space. Additional challenges exist with multi-story buildings, where rooftops are cluttered with HVAC and other equipment, creating potential shading issues for PV installations. Other red flags relate to buildings which have been engineered in such a way that they do not have the physical strength to accept the additional weight and wind loadings of a new solar power system, or buildings which have older roof membranes not expected to last as long as the potential new system to be installed on top of them.

Ground-mounted systems are definitely an option, but in urban areas the availability of

land is an issue, especially when the systems need to be left in place for a long period of time in order to recover their capital costs. Many landowners or developers simply aren't prepared to commit spare land for periods spanning a decade or more.

Parking Opportunity

Solar power project developers have begun to recognize that in many cases the best location for installing significant numbers of solar panels – where there are large areas and few obstructions – is over ground-level parking lots and multi-story garages.

Several innovative installations have been built in the past year and a half. While these early systems have been custom-engineered, a few solar equipment suppliers have recently introduced standardized, prefabricated components targeted at parking lot applications with the goal of driving down costs and making these systems much easier to install.

Some high profile examples of parking lot installations include:

- **Ground-level parking:** a 1.1 MW installation using ground-level parking shade structures to cover 700 parking spaces, at California State University at Fresno. The system is fixed tilt and uses 3,872 solar panels, providing up to 20 percent of the university's electricity needs. Completed in November 2007.
- **Parking and hybrids:** a 1.6 MW installation at the Google Inc. headquarters in Mountain View, Calif., approximately one-third of which is on fixed-tilt ground-level parking lot canopies. The system uses 9,200 solar panels and can supply up to 30 percent of the electricity needs of Google's headquarters. The company is experimenting with using it to power a fleet of up to 100 plug-in hybrid electric cars. Completed in May 2008.
- **Multi-story parking:** a 1.75 MW installation using fixed-tilt panels covering three parking garages at the Belmar commercial and residential district in Lakewood, Colo. The system uses 8,300 solar panels to satisfy five percent of Belmar's total electricity requirements. Completed in October 2008.

- **Multi-story tracking canopies:** a 1.6MW installation covering two parking garages at Arizona State University in Tempe. The systems use 8,000 solar panels mounted above 769 parking spaces. Unlike the other installations, the ASU system uses programmable controllers and hydraulic actuators to track the sun from east to west during the day, keeping the panels pointed toward the sun to increase their output. Completed in January 2009. (For more details, see related article on opposite page.)

The above examples demonstrate how ground level and multi-story parking facilities can be attractive locations for solar power systems, and some of the options which are available in terms of system design. An advantage of locating solar panels over parking spaces is that they fully or partially shade the vehicles parked underneath, keeping them cooler. Depending on the design of the system, it can also help to reduce the urban heat island effect of a parking lot or garage.

Unlike non-renewable methods of electricity generation, which typically involve an upfront capital cost plus ongoing costs for fuel such as coal or natural gas, the operating costs for solar power systems are minimal. Sunshine is free and the most valuable components are solid state. That said, the capital cost of solar power systems is considerable, with prices currently ranging from \$6m - \$8m per MW for parking canopy systems, including design and installation. One MW of system capacity generates anywhere from 900 to 2,000 megawatt hours of AC electricity per year, depending on the type of system installed and the annual amount of sunshine available.

Financing Options

While capital costs are high, a number of innovative financing options have emerged for these systems, including lease-like arrangements under which organizations seeking to benefit from solar power do not need to buy the equipment at all, just to pay for the electricity generated. These long-term arrangements are called Power Purchase Agreements (PPAs), and are offered by companies or syndicates eager to finance, own and operate the solar equipment.

Depending on the amount of sunshine and the availability of government incentives in different jurisdictions, the cost of electricity under a solar

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PPA may be more or less than the current price of grid electricity. Even if the starting price is higher, PPAs can be attractive to some electricity users because they offer long-term price certainty, in contrast to uncertain and potentially large future price increases for grid electricity. Most PPAs also include an option for the host entity to buyout the system any time after the sixth year of operation.

Owners and operators of parking facilities who are interested in solar power will want to undertake serious consideration of whether buying a system or entering into a PPA is appropriate for their own situations. Key factors will include whether near-term electricity cost savings or

longer-term price certainty – coupled with the benefit of demonstrating environmental leadership – make the proposition attractive. Assuming equipment costs continue to decline and electricity rates continue to rise, there is a good chance that more and more players in the U.S. parking industry will decide solar power is a worthwhile pursuit. ☞

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CASE STUDY

Solar Power at Arizona State University

By David Oxtoby



Arizona State University (ASU) is a leader among U.S. universities in the area of sustainability. In 2004 ASU established the Global Institute of Sustainability to “catalyze and advance interdisciplinary research on environmental, economic and social sustainability.”

ASU has also signed the American College & University Presidents Commitment, pledging among other things to begin purchasing or producing at least 15 percent of the institution’s electricity consumption from renewable sources within one year of signing.

As part of this commitment, ASU issued a Request for Proposal in 2007 seeking solar power systems for its main Tempe campus, home to more than 51,000 of ASU’s 64,000+ students. Three firms are currently under contract as a result of this solicitation. The first projects were identified, the largest of which was a 1.6 MW installation using one-axis tracking photovol-

taic (PV) canopies mounted above two existing multi-story parking garages. This project began generating electricity in December 2008.

While the university also considered a number of existing rooftops as locations for solar systems, several had drawbacks in terms of their age, the weight and wind loadings they can support, or the requirement for roof penetrations to attach the systems. “The parking structures are like a blank canvas, and enabled us to use single-axis trackers which increases the efficiency of the systems,” says Bonny Bentzin, director, Sustainable Business Practices at ASU.



For the project, ASU elected not to buy the equipment, but rather to enter into a Photovoltaic System Services Management Agreement, through which it pays a monthly amount for the electricity generated by the system and for related services. This amount is adjusted each year by the rate of inflation. Starting at the end of the sixth year ASU also has an annual option to buy the system outright.

The project was developed jointly by CarbonFree Technology, which develops projects nationwide, and SolEquity of Scottsdale, a local developer with strong roots in Arizona's solar business. System installation was led by ViaSol Energy Solutions of Tempe.

One of the challenges for the installers was that almost all of the construction took place while the university was in session. ASU is a commuter campus and the garages are heavily used, with a high percentage of spaces allocated to pass holders. Peak demand is normally during home games of the Sun Devils football team.

The installers worked closely with Parking Services, and a big effort was made to reduce the number of parking spaces taken offline at any particular time. Because the original lampposts were removed before the canopy was erected, it was also necessary to provide temporary lighting during some events.

Despite a degree of inconvenience, there was a lot of excitement at ASU about the project. "There are people on campus who are just

ecstatic, and drove by just to see how it was going," Bentzin says. "It is a really visible commitment to sustainability."

Ray Jensen, associate vice president, University Business Services, is also pleased with the outcome. "There is no downside to a project like this. We generate clean energy and manage our energy consumption costs. For us it's a win environmentally, economically and from a quality of life perspective," Jensen says.

Building on its experience, the university has plans to add solar power systems to several other building and garages over the next few years, taking the total capacity to about 7MW on the main campus plus several megawatts on its other campuses.

While the systems installed at ASU are currently among the largest at any U.S. university, the intention is not to set a record, but rather to set an example demonstrating the possibilities of solar and other areas of sustainability practice. "The whole goal is that through our leadership we will increase our efficiency and reduce our impact, while other organizations will learn from us, and that in the end we will all be leaders," Bentzin says. ☞

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