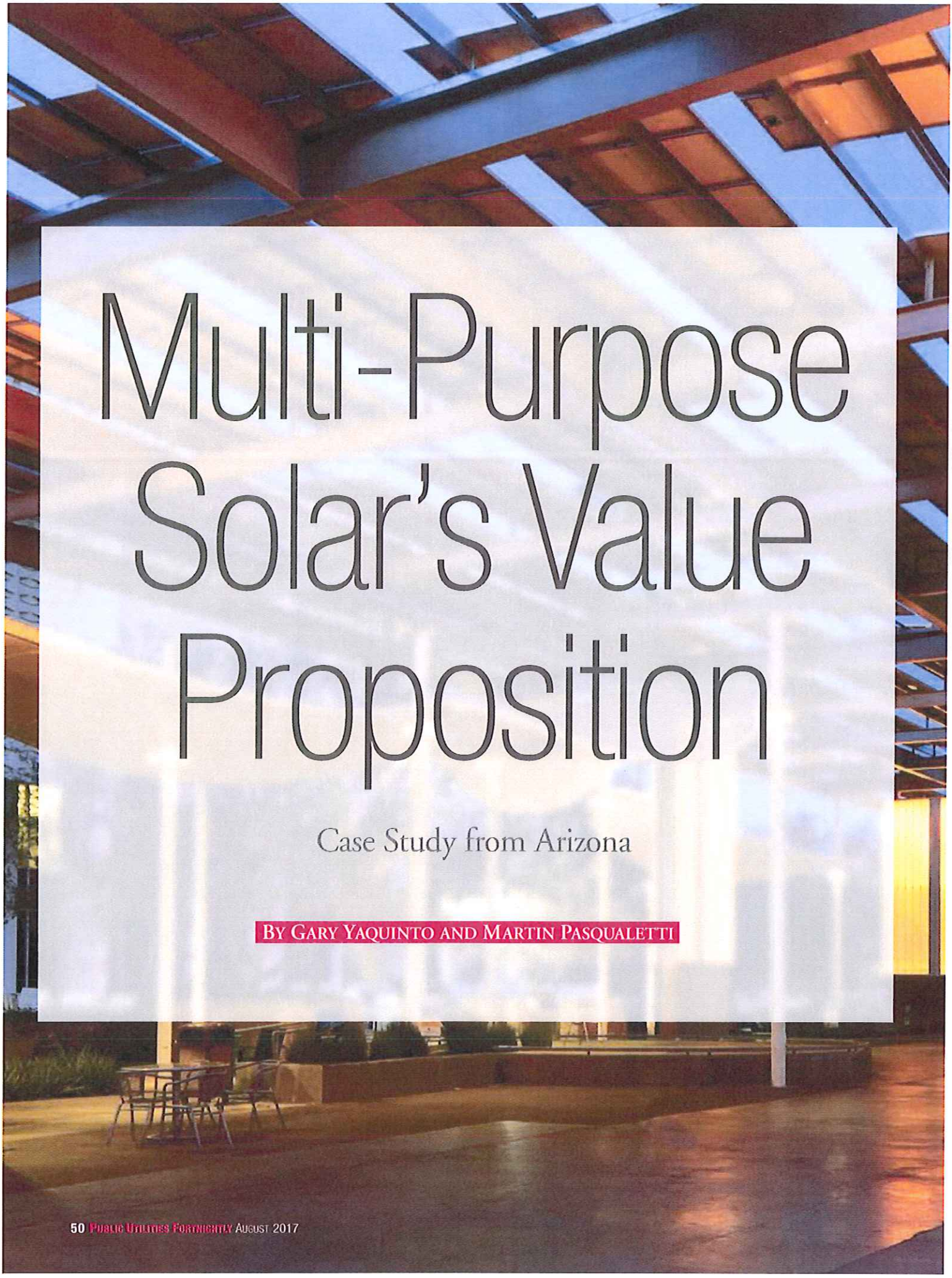

# Multi-Purpose Solar's Value Proposition

## Case Study from Arizona

By Gary Yaquinto and Martin Pasqualetti

Solar energy is becoming increasingly familiar, with modules so commonplace that they seem to be everywhere we look. We see them on rooftops, highway billboards, isolated cell towers, and mobile homes, everywhere from New York City to the Amazon Basin.

By now, just about everyone appreciates that photovoltaic cells convert the free sunshine that strikes the planet into electricity without producing greenhouse gases, and without needing the copious volumes of cooling water that can be a serious drawback for conventional power plants.

What is not as well known, but is becoming even more compelling for consumers, is that solar photovoltaics are now producing electricity at prices that are competitive with traditional energy resources.

This is all very good news for those who worry about air pollution and global warming that can accompany continued reliance on conventional energy resources. But, could solar energy be an even better deal?

In recent years, a Chandler, Arizona firm thinks it can. Strategic Solar Energy, LLC has developed a multi-purpose business model as a value proposition. Their patented technology – which they call PowerParasol® – integrates solar generation with multiple additional values for commercial applications. In so doing, it promises to quicken the adoption of solar energy. This article is a case study of their approach.

Just like all other solar installations, PowerParasol produces electricity cleanly and silently, but it is its distinct design that increases value to the owners. For example, enough light passes through to allow vegetation to flourish underneath the modules. Its support latticework provides opportunities for signage, and its creative lighting features produce nighttime ambiance and aesthetic benefits that can rival many art installations.

See Figure One.

Moreover, the unique structures add to measured employee and customer comfort and satisfaction. Taken together, PowerParasol illustrates the evolving era of multi-purpose solar technology, and we find it now installed at campgrounds, supermarkets, parking lots, and educational institutions such as Arizona State University. Because PowerParasol installations are up to thirty feet off the ground, they are even suitable for what is being called agrivoltaics, allowing agriculture to be carried out underneath, increasing the value of the land.

## Solar Energy and the Desert Southwest

Nowhere in the U.S. is the revolution in solar energy more appropriate than in the sun-drenched desert southwest. Arizona electric utilities are on course to exceed expectations in delivering clean power to their customers. State regulators are now exploring whether to modernize and possibly increase the state's renewable energy standard, originally established in 2007.

**Solar photovoltaics are now producing electricity at prices competitive with traditional energy resources.**

According to the Solar Energy Industries Association, Arizona has two thousand nine hundred and eighty-two gigawatts of installed solar capacity, ranking it third behind progressive California and just behind North Carolina.

Since 2013, the cost of PV has fallen by an average of fifteen percent per year, putting the economics of solar power near parity with conventional sources of generation like coal, nuclear, and combined cycle natural gas. However, the solar value proposition for utilities and consumers alike still faces certain hurdles to overcome if the phenomenal growth of solar power is to solidify its place within our power portfolio.

For example, even in sunny Arizona, solar power faces issues of intermittency, as it does everywhere. Plus, solar installations can require substantial amounts of land, even though the total land required per megawatt-hour from solar is comparable to the amount needed by coal plants when the entire fuel cycle is considered.

## Incubator for Solar Technology

With over three hundred days of sunshine annually to generate electricity, it's understandable that Arizona is among the top states for research, development and deployment of new solar production and storage technologies.

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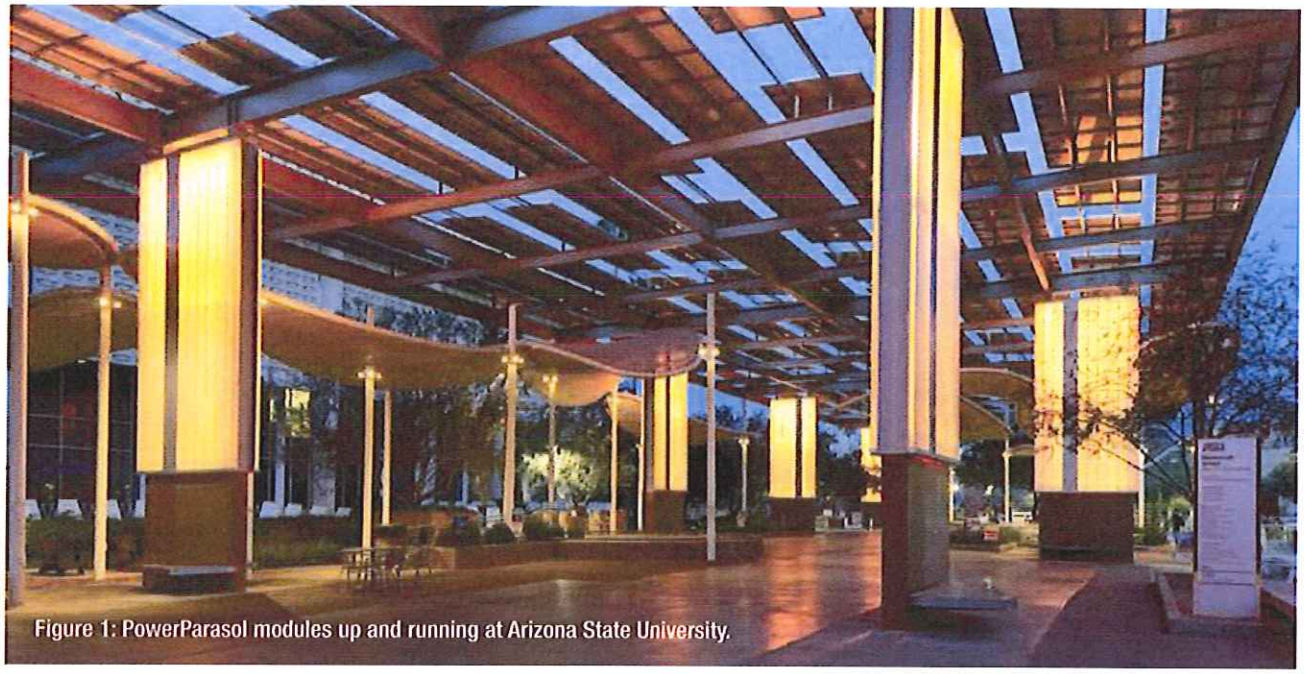


Figure 1: PowerParasol modules up and running at Arizona State University.

Arizona State University has gained recognition across the country and around the world for its research and development in areas of energy sustainability. Among its many accomplishments in the field of renewable energy, the university lays claim to the largest photovoltaic laboratory in the nation.

In addition to research and development, the university also practices what it teaches. According to Morgan Olsen, Executive Vice President, Treasurer and CFO at ASU, "Arizona State University has set a formal goal to be carbon neutral by 2025. By 2025 ASU intends to source one hundred percent of its electricity needs directly from renewable energy or through carbon offsets."

With encouragement and support from university president Michael Crow, the college was first to install PowerParasol technology. The PowerParasol structures on ASU's Tempe campus have a total installed generating capacity of three-thousand kilowatts.

With the typical rooftop residential solar installation in the Phoenix area at three kilowatts, this means that PowerParasol installations at ASU are equivalent to one thousand rooftop solar installations.

In 2016, the three installations at ASU generated about five million kilowatt-hours of electricity alone. In addition, they contributed toward meeting the university's carbon reduction goals and provided other benefits, including shading parking walkways, leisure areas and parking lots, while dramatically increasing the use of common spaces.

According to ASU's Olsen, "I believe it is creative projects that meet varied campus needs like the PowerParasols that have contributed to ASU's being ranked number one in *U.S. News and World Report's* Most Innovative Schools list for the second consecutive year in 2017."

## Land Use Solution for Solar

Large-scale solar projects by utilities and third-party developers are becoming increasingly popular throughout the Southwest. That's due to the availability of large tracts of land required for utility-scale and community-scale projects and the favorable economics of large solar projects.

In Arizona, California and Nevada, the land use footprint of utility-scale solar projects operating and under development is immense. Projects are often located in environmentally sensitive areas. Siting solar projects in these areas, however, sometimes proves difficult due to permitting regulations and other obstacles.

Environmental groups like the idea of renewable energy generation replacing fossil generation. But dedicating large tracts of pristine desert land for utility-scale renewable projects has led to increasing conflict between large-scale solar developers and environmental organizations.

Solar generation facilities located far from load centers also require access to transmission lines to deliver power where it's needed. This means that solar generation must be located near existing transmission facilities with capacity to serve, or that new transmission lines must be built. That demand may add to land use conflicts.

The PowerParasol technology helps solve sensitive land use issues. The technology combines intermediate-sized solar energy projects on private or public property with a unique value proposition in urban settings.

The technology combines features of modular solar power and energy storage opportunities that are rapidly being developed or mandated (as in California). The free-standing structures, constructed with steel-girded support towers, rise twenty-two to thirty-two feet and more above ground. Their height depends

Figure 2: On the Arizona State University campus, the PowerParasol shade canopy shields pedestrians from too much direct sunlight.

on the aesthetic and architectural design requirements of an application.

Each installation is customized to integrate with each customer's design requirements and business plan for energy savings and revenue opportunities. The higher canopy, structural design elements and asymmetrical spacing of the panels are some of the design factors that separate PowerParasol technology from other ground-based solar systems.

The structures' higher elevation above ground level allows air to circulate below the solar panels, which are also asymmetrically spaced to allow sunlight to filter to the ground. That's another patented design element. The elevation of the structure creates a micro-climate underneath.

The dappled light reaching the ground mimics the environment created by a shade tree that enables landscape vegetation to grow beneath.

In some applications that require both a shaded area and aesthetically pleasing landscapes, the dual purposes of shade and landscape vegetation produce comfort and aesthetic value in addition to the power produced by the solar panels. One example would be covered walkways for commercial establishments.

## Quest for Shade in Sunny Arizona

In wintertime, Arizona's sunny climate is the envy of places like Chicago, Cleveland, and Calgary. Come late-spring and summer, however, climate fortunes reverse. Arizona's sunshine becomes too much for these winter visitors to bear, when temperatures regularly climb well above one-hundred degrees.

Parking a car at a shopping mall in June is a hunting expedition, an exercise of locating a space beneath a tree or behind whichever building casts the most shade. Adding fuel to the fire, heat is further reflected from buildings and concrete or asphalt parking lots, and radiated within the interior of an unshaded parked car.

**The PowerParasol technology is adaptable for non-urban environments, including those far from access to electricity grids.**

At Arizona State University's main campus in Tempe, students and faculty are now able to park cars under shade, enjoy outdoor meals at the student center and walk to classes in relative comfort under PowerParasol structures.

For these applications, the power produced by the solar panels, while significant, is secondary to the shade canopy and benefits enjoyed by shielding human activities from too much direct sunlight.

See Figure Two.

The ASU Memorial Union PowerParasol is a perfect example. It shades almost one acre of concrete and desert landscape vegetation and generates six hundred eighty thousand kilowatt-hours of energy annually.

Positioned between the student union building and the main library, it has created a year-round outdoor gathering space for dining, socializing, evening movies and musical entertainment. None of these activities were common on the sun-scorched concrete mall before it was sheltered by the solar installation.

Other PowerParasol canopy projects on the ASU campus shade parking lots and driveways to campus concert halls, which also advertise campus events and double as gathering places for tailgating at sporting events and pre-concert activities.

Together the projects produce substantial electricity for the campus, all of which can be monitored in real-time on the Campus Metabolism website at cm.asu.edu. The total for all ASU campuses in 2016 was about forty-one million kilowatt-hours, avoiding twenty-one thousand metric tons of carbon dioxide equivalent.

These are the direct benefits. The indirect benefits of multi-purpose solar are more difficult to quantify but are readily apparent.


## The Value Proposition Moves Off-Campus

Once the ASU installations provided proof-of-concept for the multi-purpose approach to solar, PowerParasol installations sprang up off-campus. One of the first was in Tucson.

Arizona is a year-round destination for recreational vehicle travelers and groups. The area near Tucson, Arizona is particularly attractive to vacationers for its Sonoran Desert landscapes, hiking trails and spectacular sunsets.

As part of its business plan to improve the vacation experience for travelers, Kampgrounds of America, Inc., installed a one thousand kilowatt PowerParasol covering two acres at its thirty-five-acre Lazydays RV park outside Tucson. According to Pat Hittmeier, KOA President & CEO, "The structure is a nice vertical feature on a flat landscape and integrates well with the aesthetics of the campground."

While most of Tucson KOA's business occurs during the winter, the shade structure enables premium pricing for RV parking during the summer, thus increasing revenue during the slow season.

During its first year of operation, the Lazydays RV park lowered its power costs by approximately eighty percent through a combination of on-site generation and net metering credits. The power cost savings and additional revenue from premium shaded campsites produced a ten percent return on KOA's investment. The customary elevated roof feature provided clearance for the highest profile recreational vehicles, further increasing its value to KOA.

Grocery stores are another appropriate location for multi-purpose solar installations due to their high volume of customers. Fry's Food Stores, a subsidiary of Kroger, has installed the technology at three store locations in Phoenix.

Kroger, owner of the Fry's chain, is particularly focused on matters of environmental sustainability. The company has installed renewable energy and energy efficiency measures at many of its stores across the country.

What makes the PowerParasol technology particularly attractive to Kroger is the competitive edge it provides over its competitors. Retail grocery sales are driven in large measure by customer loyalty and return shopping trips. In making its decision to install solar, the customer-centric features available within the PowerParasol design, including lighting and signage, were important considerations.

Denis George, coordinator for Kroger, explains that Kroger takes its environmental responsibilities seriously. The company seeks technology that enhances customers' shopping experience while also lowering power costs.

PowerParasol fits the company's requirements and objectives. Based on the accumulated data of power production and the increased patronage, corporate executives at Kroger are considering adopting the same technology at other stores.

## Bringing Renewable Energy to Remote Places

Although initially designed for urban settings, the PowerParasol technology is adaptable for non-urban environments as well, including those far from access to electricity grids. The large-equipment manufacturer Caterpillar Inc., has contracted with SSE to design and construct PowerParasol Microgrid structures for remote locations around the world, where people and industry lack access to a reliable source of electricity.

Today, more than 1.3 billion people have no access to electricity and billions more need a reliable source of energy. Microgrid structures supply reliable renewable energy to remote locations to increase industrial capacity, improve agricultural production and produce clean water. They also provide shelter and protection from the sun's rays and lower costs by reducing dependence on fossil fuels.

## Policy Perspective

Numerous polls have shown that consumers like the idea of renewable energy and support efforts to encourage its development and integration into the energy portfolio. Many large businesses, such as IKEA and Wal-Mart, have ambitious goals for meeting all their power requirements from renewable sources.

Policymakers and utility regulators also support adding more renewable sources as well, since cost-effective renewable sources of power help diversify the generation portfolio and reduce reliance on fossil generation.

Over the past decade, solar energy has benefitted from incentives to renewable energy resources. These incentives have come in the forms of tax credits offered by federal and state governments and regulatory policies like net metering, which provide energy credits for solar energy returned to the grid.

These incentives have played an important role in sparking technological development and deployment of renewable energy sources. However, as the cost of solar panels has declined dramatically in recent years, so too have the subsidies that support the solar industry. Today, state legislatures and utility regulators find themselves in the middle of disputes between the distributed energy industry and grid operators.

Regulators are tasked with ascertaining the value that distributed generation installations contribute to power supply over the short-and-long term future. They must also decide how fixed grid-related costs should be equitably recovered from all customers.

Navigating the transformation of the grid toward greater amounts of distributed energy requires regulators to balance the interests of all stakeholders. It's a complex and difficult task, but one that is rendered less problematic by the increased value of multi-purpose installations.

The value proposition for owners of solar installations requires discernable benefits to proceed with installation. The benefits can be economic, lowering overall energy bills, increasing revenues for commercial enterprises, or social, reducing pollution from fossil sources of power generation.

In most commercial applications of distributed solar energy, this value proposition is critical.

Capital costs require a reasonable return and payback period, and they affect bottom line profitability. To justify a solar project, businesses must evaluate project costs, cost savings and any additional revenue streams that might be generated from a solar investment.

The multiple use concept embedded in PowerParasol technology is particularly well-suited for commercial applications that seek to capitalize on lowering energy costs and to provide convenience and amenities to customers and clients. The additional benefits and revenue streams improve the required return on investment of such installations and may lower the subsidy requirements.

This was a consideration recently when the Arizona Corporation Commission reformed the state's net metering mechanism. The reform gradually reduces subsidies over time through declining compensation rates for excess power sent back to the grid by newly added distributed energy sources.

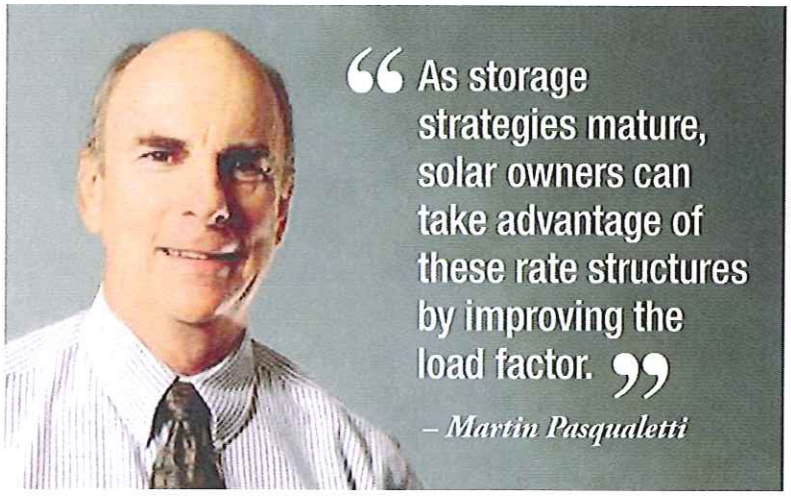
As part of its examination of distributed power sources, the ACC is also entertaining new rate structures to better align customer rates with fixed cost recovery. This includes expansion of time-of-use rate plans and implementation of optional three-part rate structures with demand charges.

As storage strategies mature, solar owners can take advantage of these rate structures by improving the load factor, lowering costs and reducing or eliminating the need for net metering as a critical factor in the decision to add solar.

Distributed energy technologies such as PowerParasol paired with battery storage can provide commercial owners and operators multiple sources of value. They are particularly attractive contributors to the transformation of the electricity grid.

## Conclusion

Transformation of the electricity grid toward greater use of distributed generation presents policymakers and regulators with decisions.




How can they best integrate these technologies into the generation portfolio while preserving the integrity of the grid for all customers? One way to increase the appeal, economic viability, and speed of adoption of renewable energy is to identify, design and promote multi-purpose applications.

PowerParasol is but one of many technologies that is emerging to address the nation's quest for sustainable energy solutions. Because the technology incorporates other amenities that contribute opportunities for new revenue streams, customer and employee comfort and interesting aesthetics, it improves the value proposition. That can help move us all toward a more sustainable energy future. PU