Going for **Solar Gigawatts** at Utilities

RENEWABLE VENTURES, A FOTOWATIO COMPANY

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A lot of the benefits of distributed solar systems are on the utility side, but it will take collaboration to assure they get counted and shared between utilities and customers.

By **JILL K. CLIBURN**

In February, while most of the country was locked in a literal and economic deep freeze, two announcements of utility plans to invest billions in solar photovoltaics (PV) burst through the frost like a couple of crocus blossoms. First, New Jersey's Public Service Electric & Gas (PSE&G) filed a plan with state regulators, proposing to invest in, own and operate 120 megawatts (MW) of PV at widely distributed sites, including city and school facilities, low-income housing sites, its own land and rooftops and some 200,000 neighborhood utility poles and streetlights. Then Pacific Gas & Electric Co. (PG&E), California's largest electric utility, announced a 500-MW PV plan, including 250 MW that the utility would own and operate and 250 MW to be owned by independent developers under power purchase agreements with the utility. According to PG&E CEO Peter Darbee, "We can't afford business as usual when it comes to protecting the environment and meeting our customers' expectations."

Indeed, if you thought that utilities would never come around to supporting solar energy, think again.

Learning to Love PV

The utility solar boom started in 2008. Since then, 28 electric utilities have announced a total of more than 2,200 MW of new PV projects, according to the Solar Electric Power Association (solarelectricpower.org). These included relatively large (25- to 200-MW) "solar farms" and widely distributed projects, such as Duke Energy's plan to scatter a total of 20 MW of PV over hundreds of North Carolina rooftops. State regulators recently cut Duke's plan by half, and some other utility plans are bound to see revisions, but the outlook is for more and bigger utility PV investments from now on. These projections do not even consider the rush by some utilities to invest in immense concentrating solar power (CSP) plants. Generation from planned

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Top 10 Utilities

Ranked by Total Solar Electric Capacity

Watts-AC per customer

1.	Southern California Edison (California)	86.0
2.	Nevada/Sierra Pacific Power (Nevada)	73.2
3.	Pacific Gas & Electric Co. (California)	28.3
4.	Kauai Island Utility Co-op (Hawaii)	24.1
5.	City of Palo Alto Utilities (California)	20.4
6.	San Diego Gas & Electric Co. (California)	19.9
7.	Tucson Electric Power Co. (Arizona)	11.9
8.	Sacramento Mun. Utility Dist. (California)	10.9
9.	Roseville Electric (California)	9.7
10.	Maui Electric Co. (Hawaii)	8.9

Source: "Special Report: Electric Utilities and Solar, A Market Review," October 2008, Solar Electric Power Association. Free download at solarelectricpower.org.

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The boom in utility-owned solar comes largely from the realization that U.S. solar capacity needs to be measured in gigawatts — and soon. Utilities get that message from aggressive state RPS standards, expected carbon regulation and rising fuel prices.

and existing CSP projects is estimated at 4,000 MW and growing. But CSP plants, which use solar heat to run turbine generators, are a lot like the central power plants that utilities are already wired to love.

PV is different — so different from traditional utility generation that solar advocates struggled for years to hammer out interconnection rules. Until recently, serious utility investment in distributed PV was practically unthinkable. In 2004, *SOLAR TODAY* ran a feature on utility solar ("Utility Prospects Under the Sun," July/August 2004) that described the distributed PV business model now proposed by PSE&G, PG&E, Duke and others as an intriguing hypothetical: "Imagine that … your utility will lease your roof to install a PV system at no direct charge to you. The deal includes an insurance policy that repairs your roof in the event of damage. The utility owns and maintains the system. … You get a discount on your electric bill, and the utility's cost savings further reduce its electric rates." The author, utility solar planning consultant Chris Robertson, at that time could point to only a few cases where a utility had decided to own or promote solar as a genuinely useful resource.

Early programs to deploy utility-owned solar, such as the popular Sacramento Municipal Utility District (smud.org) PV Pioneers, faded by the early 2000s. One big reason: deregulation. After deregulation, many utilities were discouraged — even forbidden — from owning distributed generation, including PV. Policymakers hoped to spur nonutility competitors instead to create cost-effective, nonutility solar business models.

Their hopes have borne some fruit. Supported by state renewable portfolio standards (RPS), net metering and a variety of state and federal incentives, a big part of today's solar industry is focused on installations that are owned by or directly benefit customers. Major developers, like Sun Edison (sunedison.com) and MMA Renewable Ventures (mmarenew.com), use the value of customer rebates and net metering in their business models; smaller solar companies often use energy independence and net metering — the satisfaction of seeing the meter spin backwards — in their sales pitches. As he reflects on the evolution of the industry, Robertson observes: "The customer-driven solar model has its place, but I think the question of whether solar should be customer-owned or utility-owned is the wrong question. It could be either; it should be both. The more important question is, how fast can we roll out enough solar to make a difference in meeting the challenges of rising energy demand, climate change and the need for economic stimulus?"

Robertson says he thinks the new boom in utility-owned solar comes largely from the realization that U.S. solar capacity needs to be

Enhanced grid functionality may help overcome challenges that have caused utilities to limit the amount of distributed photovoltaics allowed to connect.

Smart Grid Increases PV's Value

By **FORREST SMALL** and **SHANNON GRAHAM**

Converging forces are beginning to transform the electricity landscape. They are driving the evolution of an electricity infrastructure that is more efficient, more reliable and that integrates a diverse mix of energy resources, including renewable energy. Commonly referred to as the smart grid, this infrastructure will play a fundamental role in addressing our energy challenges over the coming years.

Navigant Consulting, with 22 of its clients, conducted a study last year to address the issue of integrating the smart grid with lots of photovoltaic (PV) systems distributed at the points of use. To do this, we asked three questions:

- Could the smart grid enable higher penetrations of distributed PV?
- Would that scenario generate new value?
- Does that new value present business opportunities?

Utility distribution systems have long been designed and optimized to deliver electricity from large central generators to end users. Changing that paradigm by putting distributed PV at or near the load raises technical questions related to managing voltage and power fluctuations on feeders. It turns out that the functionality created by the smart grid may help overcome key challenges that have limited the amount of distributed PV utilities have allowed to connect to the electric grid. These benefits are accomplished by applying

measured in gigawatts — and soon. Utilities get that message from aggressive state RPS standards, and especially from standards in states like New Jersey and Pennsylvania that set explicit solar goals and put a high value on solar renewable energy credits (RECs). Utilities everywhere anticipate adding renewables in response to expected carbon regulation. They also get the message from rising fuel prices. The run-up in natural gas prices before the current recession was cited by PG&E as a driver for one of its big solar projects, and Xcel Energy in Colorado announced a 200-MW PV project last summer partly in response to the cancellation of a natural gas plant. "Despite today's depressed energy markets, utilities know they can't bet on the long-term availability of cheap natural gas," Robertson says. "That's caused a number of utilities to look differently at the benefits of building a fuel-free, 30-year solar plant."

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— Chris Robertson, utility solar planning consultant

Maximizing the Benefits

A team led by Millennium Energy in Golden, Colo., and including Robertson and myself, recently dug deep into the question of how utilities can use solar most cost-effectively. The work was done on behalf of the Sierra Club, an intervener in two utility rate cases in Wisconsin. Using data from the utilities, the team showed that locating, designing, procuring and operating PV to offset utilities' highest costs — mostly related to peak- and intermediate-load operations — could be cost effective today. For example, for one utility, we proposed a 10-year, 518-MW distributed solar plan, offsetting peak load growth, for a net capital cost (minus incentives) of $2.1 billion. The resulting net benefit to the utility and its customers would include savings

technologies and systems that support better communications and coordinated control between distributed resources and the utility distribution system.

Our study found that by 2020, smart grid functionality could increase the penetration of distributed PV by more than 60 percent over what would likely be possible without the smart grid. This penetration would be achieved through regulatory changes in combination with the smart grid infrastructure described above. The main regulatory changes modeled in the study were increased caps on the amount of PV that could be net metered, a standardized interconnection process and enhanced electricity tariffs to allow PV owners to receive time-based payments for system output. Each of these changes would simplify the interconnection process and improve project economics to the point where the adoption of PV was higher.

More installed capacity of distributed PV, combined with the enhanced functionality of the smart grid, creates benefits for stakeholder groups including utilities, PV owners and the public. As would be expected, the electricity produced by the PV creates significant value by offsetting fossil-based central generation. By aggregating the energy produced by numerous distributed PV systems, a utility could create

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a virtual PV power plant to participate in energy markets.

When PV is combined with an electricity-storage device, the integrated system can contribute a large benefit as firm capacity (or load). The ability to create this firm capacity means that distributed PV can flatten utility load curves or potentially provide ancillary services (those needed to support transmission from seller to purchaser), creating a whole new class of resources.

Finally, integrating the smart grid with large amounts of PV with storage can provide significant grid benefits including the ability to defer investments in transmission and distribution, increased reliability and improved power quality. By coordinating control of numerous small PV inverters, a utility or third party could provide grid-optimization services to regional system operators. This work highlighted a number of important implications including these:

- A smart grid could allow utilities to relax restrictions on high penetration of PV without compromising grid performance;
- Grid benefits are further improved if utilities own PV or can influence siting in constrained areas;
- New rate and revenue-recovery mechanisms are needed to realize the identified benefits, particularly for benefits such as voltage regulation and power quality, which are difficult to quantify; and
- Energy storage is a key enabler for increasing the value of PV to both the utility and the customer.

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"We have learned that we can't just substitute solar for coal, but we have to urge utilities to start learning how to better orchestrate all their resources."

—Jennifer Feyerherm, director of the Sierra Club in Wisconsin

in seven categories — generation capacity, generation reserve, purchased power, line losses, distribution system investment deferral, procurement-related and environmental compliance — with a bottom-line value of more than $3.8 billion.

The analysis was marked by one big difference in utility operations since deregulation — the fact that generation is dispatched region-wide by an independent system operator instead of by each local utility running its own plants. As the load starts to peak, operators call on more generating plants, based on location and cost. Operators pass the fuel costs, operating costs and transmission congestion costs along to each utility in the form of locational marginal prices, or LMPs. A carefully designed solar strategy helps utilities to avoid high LMPs and other marginal costs. In short, a lot of solar benefits are found on the utility side of the meter and would be lost in a typical, customer-based solar program. A typical customer-based program would focus more simply on offsetting customers' bills.

As a result of this research, in January the Wisconsin Public Service Commission ordered a statewide utility solar collaborative to take a closer look at how Wisconsin utilities, their customers and the public at large might benefit from utility solar strategies. According to Jennifer Feyerherm, director of the Sierra Club in Wisconsin, "We have learned that we can't just substitute solar for coal, but we have to urge utilities to start learning how to better orchestrate all their resources."

The orchestration of solar with wind, biomass, energy efficiency and other new and conventional resources might ultimately revolutionize the utility industry. Some of the necessary analytic tools, smart grid technologies and business strategies are still being tested. Federal and private industry researchers are working to answer questions like, how much credit should solar receive as a capacity resource, based on its proven availability to serve peak loads? What measures, such as distributing PV over a larger geographic area or using customer load control to fill solar performance gaps, could improve utility confidence in PV? What allowances might regulators consider to balance the high investment cost of solar against its value as a long-term, fuel-free resource? This kind of research, backed by policy, could assure that more solar benefits get counted and shared between utilities and the communities they serve.

According to Fred Lynk, manager of renewables planning for PSE&G, his utility's new solar program was triggered by a combination of economic and community concerns. On the economic side, New Jersey utilities are paying the highest prices in the nation — up to $675 per megawatt-hour — for solar RECs. To comply with the state's RPS, the utility will have to cover more than 2 percent of its retail sales with RECs by 2021. PSE&G planners figure it would be cheaper, faster and surer to generate some of their own solar RECs, instead of buying them all at market prices. "We will still buy RECs from customer-owned PV, and we still have our solar loan program. We just need that much more solar," Lynk says.

In 2008, a new state law, aimed at meeting climate policy goals, opened the door for New Jersey utilities to own distributed generation, including PV. PSE&G planners took note. In November, when federal legislation extended the 30 percent solar investment tax credit (ITC) and made utilities eligible to take it, the utility put solar planning in high gear. Lynk says he hopes to get capacity credit from the regional system operator for PV's on-peak performance. Everybody involved in the program will keep working to enhance the economic benefits, but the utility is not looking for a quick payoff. Utilities have what Lynk calls "patient money" and a vested interest in helping to lead the nation's economic recovery.

PSE&G has stressed how this program, dubbed "Solar 4 All," is right for the times (pseg.com/solar). An official release notes, "We designed our program to be sure that everyone has access to the benefits of solar energy." In effect, it will bring megawatts of solar to public facilities and urban neighborhoods where individual customers might scarcely afford a solar calculator, much less a solar home. It will fast-track hundreds of green jobs and support the development of the solar industry in the region.

Moving Ahead While Pursuing the Perfect

According to Mike Taylor, utilities program manager for the Solar Electric Power Association, questions are bound to linger about whether a big rollout of utility-owned solar is in the public's best interest. A lot of solar manufacturers are looking at the utility solar boom as their best hope to grow the industry. "Once utilities are buying megawatts of solar, more plants will get built, process improvements will happen, and some costs will come down for everyone," Taylor says. But some small solar businesses, independent installers and big solar developers worry about whether utilities — traditionally the bullies on the field — can really play fair. A coalition of solar businesses and community activists in California has successfully fought some utility solar proposals, including a March ballot measure that the Los Angeles Department of Water and Power sponsored. It would have authorized more than 400 megawatts of utility-owned PV. Utility leaders hope to negotiate a revised, but similar plan.

Most solar advocates want to see allowances for broad competition and transparency in utility procurement processes. Some want provisions for union labor; others want provisions to protect nonunion shops. In light of the urgent need for more solar investment, more green jobs and an ultimate shift from utility reliance on coal, Taylor says some of his colleagues have started to repeat an old saw: "In pursuit of the perfect, be sure the good is not lost." **ST**