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FEATURE

Recent Developments to Consider . . . When Considering Photovoltaics for Your Facilities

Barry Friedman and Peter Salmon

In a period of remarkably volatile natural gas prices, increasing electricity retail rates in some areas, and new domestic policies to encourage the use of solar electricity, this is a good time for corporate energy managers (CEMs) to understand what the solar opportunity may mean for their businesses. Regardless of their company management's level of interest in or particular bent regarding solar power, or of the specific market conditions in which they find themselves, they need to have at least a cursory knowledge of the "big-ticket" considerations involved in a decision to install an on-site solar system. These considerations range from the technical to the regulatory to the cost/benefit picture.

"The solar power industry has been on a tear," reported *BusinessWeek* in its February 6, 2006, issue, citing more than 30 percent annual growth over the past six years.[1] Well-known organizations that have installed photovoltaic (PV) systems in recent years include Whole Foods; Johnson & Johnson; Toyota; Staples; Walgreens; Wal-Mart; Lowe's; Federal Express; and several U.S. cities, other government agencies, and universities. Has something changed to catch people's attention after many years of a certain amount of solar hype? We conclude that there are indeed new opportunities, but they are more modest than they are sometimes portrayed.

Concerns about electricity rates, continued technical innovation, a new federal tax credit, and economies of scale have made large installations at commercial customer sites increasingly appealing, both on roofs and on land (**Figure 1**, page 2).[2] Improved efficiency and economies of scale are bringing down costs but are doing so gradually. Many businesses are attracted to PV systems because, in addition to their

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Figure 1: A solar array at the Johnson & Johnson Consumer Products facility

On October 24, 2005, three acres of PowerLight Corp.'s solar PowerTracker ground product were dedicated by Johnson & Johnson Consumer Products at its New Jersey site. This solar electric system is the largest and highest-output solar tracking array on the East Coast.

Courtesy: PowerLight Corp. [2]

other benefits, their electricity generation is coincident with the time of peak loads, potentially reducing the highest time-of-use rates and in some areas onerous demand charges. Finally, a new "low-hassle" power purchase agreement model for solar energy is beginning to attract mainstream attention as a way to avoid a large capital investment and still install PV systems.

With all this interest, the PV industry has been stymied by a product shortage due to the increased demand. Although solar is overall a marginally better and lower-cost opportunity than it was in the past, it is still a very expensive way to generate energy, appropriate mainly for companies with compelling noneconomic motivation to move forward on such projects. However, companies that have been strongly considering solar should realize that there are more subsidies available now than ever before and that, depending on where in the U.S. they operate, their retail electric rates have likely increased or will do so over the next 25 years.

Rising Energy Prices and a New Federal Incentive: A One-Two Punch?

One: Energy price volatility and escalation. Rising energy prices and energy volatility in recent years have been dramatic: California's energy crisis and Northeast power outages were just part of a now-familiar litany of energy uncertainties that has brought public attention back to renewable energy. Demand is steadily increasing in most regions, and natural gas prices soared in 2005 to more than $13 per million Btu (MMBtu) in some places, not the first gas spike to shock the industry in recent years. We believe the floor for natural gas prices will stay at about $8.00 per MMBtu, driving up retail electricity prices in areas (such as Texas and California) that rely on natural gas for baseload.[3]

We believe other regions' retail commercial electricity rates will get pulled up more slowly, but they will increase as well.[4] This prediction is consistent with recent trends. Average U.S. commercial retail electric rates have increased slowly but steadily in each of the past three years.[5] To cite just one example from recent news, Connecticut Light & Power announced a 23 percent rate hike in January 2006.[6] However, some of the U.S. Energy Information Administration's projections are more optimistic about commercial rates, actually showing consistent decreases in energy prices over the next five years. In the end, CEMs should do what they can to evaluate how their individual utilities' situations are likely to affect future rates and thus the hedge value of solar energy.

The reality is that most energy managers expect energy rates to increase in most U.S. regions; these expectations likely contributed to a record 105 solar megawatts (MW) installed in the U.S. in 2005 (about a 17 percent growth over

2004).[7] If you expect your rates to increase, you should evaluate the value of solar power as one of the few physical hedges against these increases. Energy managers who are familiar with U.S. green pricing know that it is just such a hedge value that made Austin Energy's green pricing program the largest in the U.S. Austin's GreenChoice program provides fixed-rate renewable energy for its customers, in some cases for a significant portion of their load. Never mind the environmental benefits—many Austin business managers have come to view renewable energy as a valuable insurance policy in volatile times.

But the green pricing hedge is available only from the dozen or so programs that offer it. Solar power can provide the same benefit to customers, whether or not they have access to a green pricing program that provides exemption from fuel cost adjustments. The catch is that unlike the green pricing hedge, the solar hedge functions on the margins, in most cases covering only a small percentage of a facility's load.

Two: EPAct 2005. In 2005 the U.S. government took a rather dramatic step to boost both the viability and visibility of U.S. solar power. The Energy Policy Act of 2005 (EPAct 2005) offers a tax credit for businesses equal to 30 percent of the eligible solar property placed into service from January 1, 2006, through December 31, 2007.[8] The biggest drawback of the federal credit is this short two-year window in which to plan and install.

The incentive is a tax credit, not a deduction. It is a direct reduction in the amount of taxes owed equal to 30 percent of the system's installed cost. Eligible property includes photovoltaic systems; concentrating solar equipment; solar thermal systems such as flat-plate and evacuated tube collectors for space and water heating; and solar lighting, a method of using sunlight and fiber-optic cables to illuminate an interior space. A partial tax credit of 10 percent is available for systems partly placed into service before or after the tax-credit period. For example, if 70 percent of a system is constructed in 2007 and the remaining 30 percent in 2008, then the business can claim 24 of the possible 30 percent, following a formula outlined in the act.

EPAct 2005 is having at least three positive impacts on the growth of commercial solar power.[9] First, EPAct 2005 raised awareness at the state level so that several states are reevaluating their efforts, in some cases looking at developing an incentive program where none existed before. Second, the extra financial incentive from the federal government enabled states such as New Jersey to reduce the maximum amount available for a given commercial project without compromising the go-ahead prospects for that project (the federal credit makes up the difference). This in turn enables the dollar amount set aside for New Jersey projects to be stretched over more projects this year and next than would otherwise have been possible.

Finally, EPAct 2005 has provided an economic benefit to businesses installing solar that made such projects viable in states where they had not been viable previously; North Carolina is the most-cited example, but there are others. North Carolina's 35 percent tax credit is enough to make certain projects viable when it is combined with the 30 percent federal credit; the federal credit is generally not enough to get a go-ahead for a project without some state incentive as well. The exception is where there are exorbitant electric rates, such as those in Hawaii. Some CEMs have business operations in states with marginal incentive programs, such as Arizona, North Carolina, and

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Pennsylvania (**Figure 2**).[10] These are the states where the federal tax credit can have the most impact on project feasibility. Because the window for the federal tax credit is a short two years, CEMs with operations in these states should begin immediately to analyze their opportunities. For an in-depth discussion of the tax credit's value, we suggest a March 2006 study from the Lawrence Berkeley National Laboratory and the Clean Energy States Alliance titled "Exploring the Economic Value of EPAct 2005's PV Tax Credits," which is available for download at http://eetd.lbl.gov/ea/emp/cases/LBNL_59928.pdf.

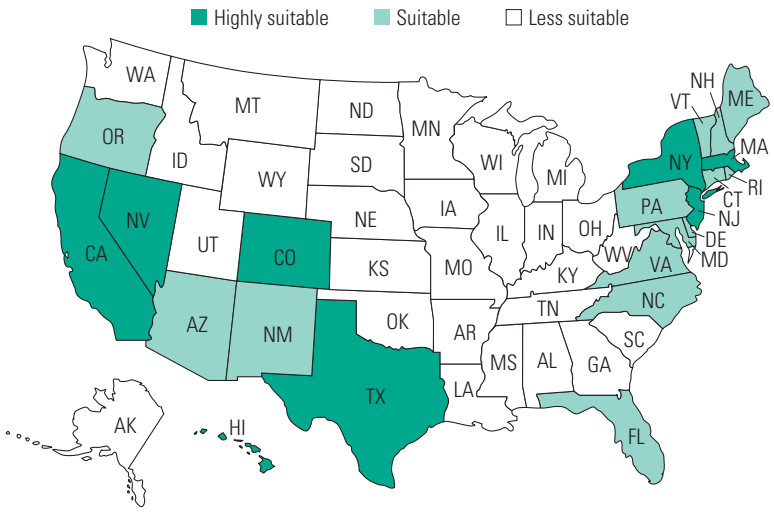
Supply Shortage

With high energy prices and the 30 percent tax credit creating favorable conditions for a go-ahead decision on solar power, one major factor on the other side of the ledger must also be understood. The worldwide solar industry is suffering a PV panel supply shortage, causing frustrating delays, increasing prices, and increasing pressure, particularly on smaller integrators that may lack the negotiating power of their large international competitors when dealing with key vendors. The shortage has slowed the industry down considerably, from more than 50 percent growth in 2004 to a projected 5 percent in 2006.[11] Large projects and projects with the right economics can usually still go forward, but the shortage means delays, usually of 5 to 12 months, between the time a project is finalized and delivery and installation of the PV panels. Expect shorter delays when dealing with large national or international installers, who often have direct relationships with global manufacturers based on high-volume purchases.

The panel supply shortage is a result of a worldwide shortage in the ultrapure polysilicon used in PV panels. The limitation is in manufacturing capacity for the silicon, in turn caused by the extraordinary rise in PV panel demand created by government-backed incentives around the world. In fact, within two years the solar industry's use of silicon will outstrip that of the other large silicon consumer: the semiconductor industry. The biggest component of the increased demand is the boost Germany gave to its market through a "feed-in" tariff of more than 55 cents per kilowatt-hour (kWh), plus recent news-making pushes in Japan, Spain, Italy, California, and elsewhere.

Figure 2: State-by-state site suitability

The states shown in red are the most conducive to PV installation, whereas those in gold are marginal. The federal tax credit available for 2006 and 2007 projects may help make some projects feasible in these marginal states.



Courtesy: PowerLight Corp. [2]

Although silicon manufacturers have been slower to respond than the industry might like, they are responding. The good news is that most of the experts to whom we spoke expect increased capacity to ease the problem by 2007 and solve it by 2008. "We're in the tightest part of the market now," Rhone Resch, president of the Solar Energy Industries Association (SEIA), told us. "But the market is responding. Eight of the top-10 polysilicon manufacturers have announced plant expansions dedicated to producing solar-grade silicon." Even though only four of the eight

are building in the U.S., the expanded capacity worldwide will help alleviate the problem in the U.S. by early 2008, Resch said.[12] In 2005 28,000 tons of polysilicon were produced worldwide for all uses of polysilicon combined. By 2008 Resch expects that number to exceed 50,000 tons, with virtually the entire difference attributable to the PV demand. Once the shortage ends, there are several macrotrends that could support solar energy's long-term prospects: increasing economies of scale, global participation from large markets such as China, and continued technological improvements.[13]

Value Proposition

Benefits. The clearest benefit of solar energy does not require a lot of explanation: "curb appeal." If your company has an environmental or sustainability plan, solar power on the rooftop or grounds is one of the most attention-getting moves you can make. Your stakeholders will see you conspicuously "walking your talk," and local school groups and community members will visit and recognize your efforts. For this reason, energy managers with whom we spoke agreed that they accept longer paybacks and somewhat lower returns for solar projects than other energy-related initiatives. Solar installations tend to attract "earned media" and become a source of pleasure for your corporate communications department.

But CEMs wishing to make a cut-and-dried business case for solar energy will have a tougher time. PV systems are expensive, and payback is often six years or more, a significantly longer period than that for traditional energy projects. But if your electricity rates are rising for the foreseeable future, then, even if you can get the four- or five-year paybacks possible in the most amenable states, you may still feel that an investment in a 25-to-30-year generating asset with an 8-to-12-year payback makes sense. Solar systems are gradually getting less expensive, paybacks are helped in certain places by rising electricity prices, there has been some technical innovation, and there are better subsidies than have been available in the past. But the essential economic obstacles to PV systems still remain. The difference now is that in certain limited circumstances, the economics are strong enough to put some companies over the top of the fence. Solar power also serves as a physical hedge against rising energy prices, though for a very small percentage of most facilities' load.

Another important benefit for CEMs to track is the value of the solar renewable energy credits (S-RECs) derived from each megawatt-hour (MWh) of solar energy they generate. There is a voluntary market for S-RECs, but their value in that market is not likely to make a substantial difference in the payback of a project. However, New Jersey has developed an S-REC market to help utilities comply with the state's renewable portfolio standard (RPS), helping the economics of projects in that state considerably. CEMs with operations in Nevada, New York, Texas, Arizona, Colorado, and other states with solar or nonwind "carve-outs" (also sometimes referred to as "set-asides") should watch to see whether and how such compliance markets develop there. Only Nevada has a greater S-REC value than New Jersey, but Nevada has a 30-kilowatt alternating current (AC) size limit on projects and a request-for-proposal (RFP) process that is more cumbersome than New Jersey's rebate program.[14]

Other benefits of solar energy usually include increased real property value of the facility (relevant for owners and operators); reduction of peak demand charges and peak energy prices (more significant in some areas than others); and in some cases reduced need for roof maintenance and improved rooftop insulation, resulting

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in reduced HVAC requirements. Solar power can also be used for backup power if it is supported by the buffer of a battery system or genset, but that is not generally a driver for a solar energy purchase.

The internal rate of return (IRR) and payback for solar projects depend, for all practical purposes, on the level of state subsidy through tax credits, rebates, the sale of RECs, and other means. In California, where rebates are about $2.80 per watt at the time of this writing, and particularly in New Jersey, where rebates currently range from about $3.10 to $3.70 per watt depending on the size of the project, paybacks can be as little as four to six years and annual IRR 10 percent or more.[15] Elsewhere, depending on the state, paybacks can take much longer.

"You have to decide whether you want to spend your capital on solar projects or on your core business."

There are two distinct components to the potential energy savings of solar power. The first is avoided energy costs; every kWh the solar system generates over its 25-to-30-year (or more) life is of value against the capital investment of the installation. The second is the hedge value—a fixed or known electricity cost functioning as insurance for the solar portion of your facility's consumption over a period of 10 or 20 years. The solar energy becomes more valuable every time your utility raises its rates.

Costs. By 2008 stepped-up silicon manufacturing capability may help reset the slow-but-steady course of PV systems' cost reduction. SEIA's Resch told E SOURCE he expects that reduction to be as much as 5 percent per year.[16] But cost reductions will depend upon how long it takes for the increased production capacity to catch up with the demand backlog. From 2006 to 2008 (which happens to be the two-year window of the federal tax incentive), prices should remain fairly flat or increase modestly.

The goal of the industry is to bring the current installed cost for large projects, about $6 per watt (not counting incentives), down to about $3 within 10 years, according to Resch.[17] For smaller commercial projects, costs range from about $7 to $10 per watt or even more, depending upon the installer and the region. Resch's projected annual cost reduction of 5 percent is consistent with past trends, but in reality there is no way to know how PV system costs will change in the future, especially since demand driven by new government subsidies could continue to outpace supply. For now the cost of PV is still prohibitive for many businesses, and in most states EPAct 2005 has done little to change that. The short two-year window for the federal tax credit also makes planning for that piece of the economic puzzle problematic for some projects.

In evaluating the investment, CEMs have to be cognizant of overall business goals because, as one energy manager pointed out, "you have to decide whether you want to spend your capital on solar projects or on your core business." In many cases the tangible return on the latter is clearly superior. Though costs may continue to gradually decline when the promised silicon capacity comes on-line in 2008, payback in most states is still eight years or more. Even in states with rebate programs, payback is usually more than six years.

Power purchase agreements. CEMs might also consider not buying the systems at all. There is an emerging and rapidly growing model in which installers retain ownership of the installations on your site and sell you the energy under a long-term fixed-price power purchase agreement (PPA). In some states, such as New Jersey, it is possible to buy such energy at a rate that is all but guaranteed to remain lower than your utility rates during the hours of solar operation, allowing you to save money while receiving the

benefits of solar power. Recent and pending large solar deals have opted for this model. For example, the most extensive U.S. solar deal to date, made by Walgreens in January 2006 for more than 100 facilities in New Jersey and California, utilizes the PPA model of third-party ownership, as opposed to self-ownership.[18] This model will work best for CEMs with limited access to inexpensive capital, who function in a risk-averse climate, or who simply want a lower-hassle way to get solar energy up and running.

For some energy managers a PPA is not feasible from a liability standpoint. As Dennis Canavan of Johnson & Johnson pointed out, "It's very difficult to write a contract to have someone else own and operate equipment on your property. If that equipment caused a problem, they could be liable, and if it's a plant that makes product, no one would be willing to take on that kind of liability."[19]

State-by-State Differences

The IRR and payback from solar are primarily a function not of size but of the particular U.S. state or states in which you are considering an installation. A number of online tools can help CEMs evaluate potential projects. One such tool, called PV WATTS, was developed by the National Renewable Energy Laboratory (NREL) to "permit non-experts to quickly obtain performance estimates for grid-connected PV systems within the United States and its territories."[20] PV WATTS may be found at http://rredc.nrel.gov/solar/codes_algs/PVWATTS.

A good tool to evaluate the economics of a potential project and compare one state to another is the New Jersey Clean Power Estimator. Despite the name, the Estimator covers projects in any U.S. zip code. The Estimator handles most of the factors and assumptions required for a thorough evaluation, including available rebates, tax implications, discount rate assumptions, roof tilt angles, and size of energy bill assumptions. The Estimator can be found at www.njcep.com/html/estimator_f.html. Another potentially useful free tool in evaluating your project or looking for case studies is Natural Resources Canada's "RETScreen," which you can download at www.retscreen.net/ang/g_photo.php.

Another important web site for your "key solar URLs" folder is the database at the North Carolina Solar Center, www.dsireusa.org, which includes summary tables and click-through detail on state and utility rebate programs, along with other useful information such as net metering regulations.

The relative hospitality to solar of one state compared with the next is a function of several variables. Among these the three big-ticket items are, in order of importance:

- Available project rebates and other incentives
- High electricity rates
- Available sunlight resource[21]

The states that offer the best combination of these three factors are New Jersey and California. In these states projects can receive an IRR of as much as 12 to 15 percent per year, with payback typically in the range of five to eight years. Some New Jersey projects can pay back in as little as four years, so compelling is the "perfect storm" there: the combination of fairly high rates, very generous rebates, and the added factor of a robust market for S-RECs created by the New Jersey RPS. S-RECs in New Jersey sell for a minimum of $15 to

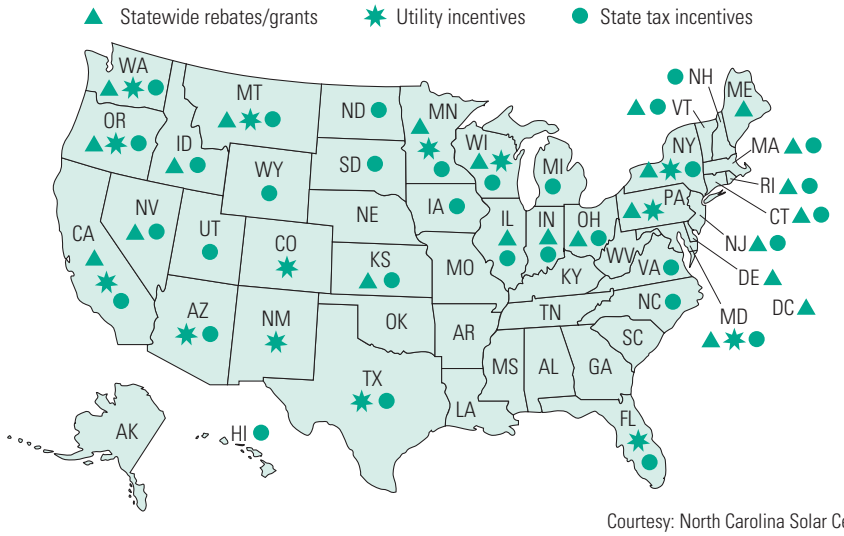
$25 per MWh, making an enormous difference in the economics of a project there.

Governments of several other U.S. states are trying to make their states the next place to think of when you think of solar. The best states not only provide a high per-watt rebate but also have enough money in the pot so that you're likely to get your rebate application approved. Overall, the hot spots remain dominated by the coastal states. Most notably, the most hospitable states include New York, Connecticut, Rhode Island, and Massachusetts in the East and Nevada, Texas, Arizona (through the utilities there), and Colorado (for smaller commercial projects) in the West (**Figure 3**).[22] If your facilities sit in pockets of the country dealing with grid congestion, the inability to build new transmission lines, and/or high peak power costs, look for better state and utility financial incentives coming your way in the next couple of years, if they aren't in place already.

Some states still have work to do in simplifying their rebate processes, especially those such as Nevada with an RFP process. These include New York, Connecticut, Rhode Island, Massachusetts, and Delaware. These processes can be costly and time-consuming for installers, and at the end of the process there is no guarantee that the grant money will come through.[23] Compounding this problem is the existence of multiple rebate programs in some states—private, utility, state agency, and other (see Figure 3).[24] The RFP problem is significant enough that PowerLight Corp., one of the largest installers in the U.S., largely avoids RFP states, at least in terms of developing a significant marketing presence.[25] The RFP issues are contrasted with states such as New Jersey and California, which employ rebate application processes that are not nearly as cumbersome and have a greater likelihood of getting the actual pot of gold at the end of the rainbow.

Figure 3: State rebates and tax incentives; utility incentives

This map shows the available incentives for solar power on a state-by-state basis.



Courtesy: North Carolina Solar Center [14]

Notes

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3 Tom Woods (February 22, 2006), Senior Consultant, Platts, Boulder, CO, 720-548-5655, tom_woods@platts.com.

4 Neil Kolwey (February 23, 2006), Research Manager, Platts, 720-548-5741, neil_kolwey@platts.com.

5 Nicholas Schmidt (February 28, 2006), Product Support Specialist, Platts, Boulder, CO, 720-548-5659, nicholas_schmidt@platts.com.

6 Charlie Moret (February 27, 2006), Managing Director, Marketing and Communications, Connecticut Innovations, Rocky Hill, CT, 860-995-2318, charlie.moret@ctinnovations.com.

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