PREFACE

Solar power is booming across the U.S.—solar installations accounted for 48% of all the new energy production capacity installed during the first quarter of 2013[i]—but for many people it remains a mysterious and even daunting subject. Sadly, this is especially true for those who could benefit the most from installing solar: the owners and operators of commercial buildings.

Faced with ever higher costs from electric rates that are constantly increasing, producing your own energy to save money certainly *seems* attractive. But how can a harried facilities manager find reliable answers to the myriad questions that present themselves: How can you identify qualified contractors? How do you go about assessing their competing bids? How should your company pay for it? And how can you even get started when you don't know what questions to ask in the first place?

If these questions sound familiar, this book is for you.

In the pages that follow you will meet Jack Prince, facilities manager for expanding bio-tech company EnGex, who suddenly finds himself tasked with determining whether his company should "go solar." Through a series of dialogues between Jack and his colleagues that frame the issues, followed by subsequent discussions that provide greater detail, you will follow Jack as he learns all that he needs to know about commercial solar power systems: from mastering the basics to commissioning the installed system. And, because in the real world the story doesn't end there, we will also present two case studies about actual

commercial solar installations a year after the fact, but with very different endings.

My hope is that this book will help demystify the process and clarify the benefits of going solar, step-by-step.

After years as a scientist, educator and trial lawyer, I founded Run on Sun in 2006 because I believed that there was a niche to be filled by a solar company run by people who could answer a client's questions in a clear and concise manner. I knew from my years as a scientist at Bell Labs that technical details mattered, but I also knew from teaching that the "curse of knowledge" left many "experts" incapable of explaining technical subjects to an educated, albeit lay, audience. And I knew as a trial lawyer that sophisticated decision makers—whether Judges or CEOs—had well developed abilities to sense "the ring of truth," even if they didn't understand the subject matter well enough to know what the "truth" was.

In the years since I have come to believe that all of those considerations are even more important today than they were seven years ago.

This book is the result of that experience. I hope it helps.

Jim Jenal

Pasadena, California, September 2013

Chapter Notes

[i] *Solar accounts for 48% of new electric capacity in Q1 2013,* from U.S. Solar Market Insight Q1 2013 by GTM Research/SEIA®, available at http://www.seia.org/research-resources/us-solar-market-insight-q1-2013, accessed 6/16/2013.

I. INTRODUCTION: WHY GO SOLAR AT ALL?

MEET JACK PRINCE

Jack Prince looked at the phone on his desk and scowled. It wasn't that it was ringing—Jack's phone was always ringing. No, it was the name that popped up on his caller-id screen that was causing his consternation. Amy Peller, CFO at EnGex, was on the line, and Jack was certain this wasn't a social call.

"Hi Amy," Jack answered. "What's up?"

"Have you seen these bills?" Amy demanded in her typical, no-preamble approach to conversations. Amy always knew exactly what was on her mind. Unfortunately, her subordinates only occasionally did. This was one of those awkward moments for Jack.

"Which bills do you mean?" he asked, knowing even as he did, that it was the wrong question to ask.

"These electric bills, Jack!" Amy exclaimed. "They are completely out of control. What are you going to do about them?"

Jack sighed. As facilities manager it was his job to be on top of operating expenses for the five buildings that comprised the EnGex campus, and he had made substantial efforts to limit their energy usage even as the company grew. But recent rate increases for the local power company—seventeen percent over just the last three years—threatened to overwhelm his best efforts to date. From the edge in her voice it sounded as if Amy had reached the same conclusion.

Jack considered his words carefully.

"I think we have already picked all of the low-hanging fruit. If we are really going to make a dent in our electric bills, we are going to have to take a more aggressive approach."

Now it was Amy's turn to sigh.

"Look, Jack, I know you are good at what you do and heaven knows we would be way worse off if it weren't for all the clever changes you've introduced over these past five years. So please, don't get me wrong—I'm not faulting you. It's just that we need to have a plan that will give us some assurance that we can get these costs under control.

"I need you to figure this out—and soon. Our annual meeting is in six weeks and Jason is going to want us to give him something concrete to bring to the Board."

Six weeks. Jack's stomach turned—not a lot of time to come up with something "concrete" to solve the problem of higher electric bills.

"I'm on it," he said.

"Good, for both our sakes," replied Amy, hanging up.

Jack knew that Amy was right. In the nearly six years that he had been facilities manager at EnGex he had only spoken one-on-one with CEO Jason Loudon a handful of times but the impression was indelible: Loudon was a bottom-line kinda guy. If something didn't pencil out economically, it was a non-starter with him. That said, he willingly supported good ideas and rewarded success handsomely. Failure, on the other hand, received an equally vigorous—if markedly less pleasant—response.

Jack would have to get creative; the easy things had already been done, so now what? Jack's stomach twisted a little more.

As he sat there trying to formulate a plan, one presented itself to him by way of yet another phone call, this time from Janet Lang, Director of Engineering.

"Hey Jack, I know you are busy, but I just saw something pretty impressive, and I thought of you. Do you have a second?"

"For you, sure," said Jack. Janet was an ally and very smart. Her insights had proved helpful in the past. "What's on your mind?"

"I just came from the company where my daughter Lena works, and she was really excited about what they are doing there. Apparently they just installed a solar power system on their warehouse roof, and she told me that they expect the system to pay for itself in four to five years while saving them something like sixty-five percent on their energy bills every year.

"Anyway, I know you are always looking for ways to improve things around here, so I thought I would mention it to you."

"Oh, I don't know," said Jack. "We looked at solar a few years ago and it just didn't pencil out."

"How long ago was that, Jack?" asked Janet. "According to Lena, they were really skeptical at first, but the economics of it really wowed them."

"Well, now that you mention it, it was probably close to ten years ago. Do you really think that could work for us?"

"I don't know, but ten years is an awfully long time when you are talking about a high tech industry like solar. I can find out from Lena who they used at her company. What have you got to lose?"

"Nothing," Jack said, half to himself. "Nothing at all. Thanks, Janet. As always you've made my day. Please ask Lena for the contact information, and thanks again."

For many facility managers and building owners alike, Jack's problem sounds all too familiar. Jack's boss, like many a boss trying to run a successful business, is focused on the bottom line and rising operating costs are a cancer, eating away at the company's profitability. They are well aware of rising energy costs and they have already done "the easy things"—upgraded their lighting, replaced antiquated air conditioning equipment with more efficient HVAC systems, even installed "smart controls" in an effort to reduce their peak power demand—but still their monthly bills rise. They need a new approach, and they need it now.

It is the central premise of this book that a commercial solar power system is just what Jack and his boss are looking for to get out of their present predicament. And to be sure, while there are numerous reasons for adding solar beyond the economics, few companies can commit to going forward if the economics don't make sense.

In the coming pages you will follow Jack as he progresses, step-by-step, to learn what he needs to know to understand how solar can help EnGex save real money. He will learn what is hiding in those ever rising electric bills, and he will figure out how to locate not just

one, but several reliable solar contractors to provide him with comprehensive proposals.

We will watch as Jack sifts through the competing proposals and see how he figures out how EnGex should finance their system. Then, with a contract signed, we will learn from Jack's experience in overseeing the installation process from pulling permits to processing rebates.

Jack doesn't know it yet, but he is about to become an expert on how to get a commercial solar power system installed.

And so are you.

II. PRELIMINARIES: WHAT YOU NEED TO KNOW FIRST

JACK DOES SOME HOMEWORK

Like water, trouble also flows downhill, and Jack's next call was to Terri Flint, a local energy efficiency consultant who had been his go-to person on the HVAC replacement project EnGex did two years ago. Jack figured that her expertise could come in handy now.

"Hi Terri, it's Jack, and I really need your help."

"Sure, Jack, what can I do for you?" Terri asked.

Jack recounted his conversations so far. "I was hoping you could give me some ideas on how to get started," he concluded.

"Absolutely," Terri replied, "happy to help. Let me ask you this—how much do you actually know about your electric bills?"

"Well, I know that they are too high to please my CFO!"

"Right—no surprise there. But have you actually looked at how your bill is computed?"

"Not really," Jack confessed, feeling a bit sheepish. "I looked at them a few years ago after I read an article about commercial customers being routinely overcharged. But I really had a hard time figuring out how they came up with the numbers that they did. Does anyone actually understand those bills?"

"Sure," Terri laughed, "we do. And a reputable solar installation company certainly should. In fact, if you talk with a solar company and they can't explain exactly

what is going on with your current bills, you need to talk to a different solar company!"

"Good point," said Jack, "I'll keep that in mind. But right now I don't even know what questions to ask—I guess I don't know what I don't know."

"Ok, let's go over some basics," Terri agreed. "Most commercial utility customers are charged for electricity in two ways: usage and peak demand. Usage is easy; that is how you are billed at home—the more energy you use in a month, the bigger your bill gets.

"But demand is sneaky. It is based on the highest spike of power that your building draws during the entire billing cycle, and it can really increase your overall bill."

"Are you saying that turning everything on at the same time every morning might actually be increasing my electric bills?" asked Jack.

"Without a doubt," Terri replied. "Your solar installer should look over a year's worth of your bills and be able to explain to you where your money is being spent. They should also have detailed models that actually track the rates charged by the utility so that they can give you an accurate estimate of how much your solar system will save you."

"Okay, what else do I need to know?"

"Are you familiar with net metering?"

"I've heard the term before," said Jack. "Doesn't it have something to do with how you get billed when you have a solar power system?"

"That's right. Under a net-metering agreement, the utility will install a new meter that can measure and record energy flow in both directions. When the solar

power system produces more energy than you are consuming with your loads, that excess energy will flow out onto the grid and you will get a credit for it. At night, or on a stormy day when the system isn't producing much energy, or none at all, you will draw energy from the grid to power your loads, and the meter will keep track of that as well.

"At the end of each month, the utility nets those two numbers out. If you consumed more than you produced, you are a net energy *importer* and you will pay for that balance. On the other hand, if your system is large enough so that you are a net energy *exporter* at the end of the billing cycle, the excess will be carried forward as a credit to the next cycle."

"Ok, what else?"

"You will want to know about rebates," said Terri. "Most utilities will pay rebates for commercial systems based on the actual amount of energy that your system produces. Those rebates are generally paid over a number of years, most commonly five."

"Oh, but Lena's neighbor just put solar on his house and he got his rebate all at once," protested Jack. "I know because he made a big deal out of bringing over the check and bragging about it to her."

"For residential and really small commercial systems, rebates are paid out in one lump sum when the system is commissioned," Terri explained. "But for larger systems, like what you will need for EnGex, the utilities like to spread out the payments over time – and only pay for the power that actually gets produced."

Jack nodded. "I guess I can't fault that logic. I wouldn't want to pay for something I didn't get either. Anything else I need to keep in mind?"

"The last thing is a bit out of my realm, but you should talk to the company's tax accountant about the available federal and state tax incentives. The most significant one is the thirty percent federal Investment Tax Credit, but there are also federal and state depreciation formulas that may apply. As I said, that's a bit out of my depth, but your accountant can explain that to you."

"Wow, thirty percent? I had no idea. I'll walk over to accounting and see if someone can give me the details. This has been really helpful. Thanks, Terri."

"No problem at all, Jack. Good luck."

As many companies sit on the sidelines with accumulated capital, spending some of that capital on a commercial solar power system often makes great economic sense. But for some companies (and their facility managers, accountants, Board Members, *etc.*), commercial solar is still a confusing concept, filled with impenetrable jargon and competing claims. Can a commercial solar power system really be as economically beneficial as the proponents claim?

Rather than answer that question directly, it is useful first to lay out the case for commercial solar power in some detail. Although no chapter in a book can take the place of a face-to-face conversation that takes into consideration all of the unique elements of a specific company's situation, there are enough common elements that can and should be explained to demystify the overall process before that conversation ever takes place.

First things first. Before you ever call a solar power company—and we will explain how to find the good ones later in this chapter—you need to start with something more mundane: your electric bill. When was the last time that you really looked at your electric bill? For many business or building owners the answer is never. Oh sure, you certainly know how much you are paying—but do you know *why* you are paying so much? What horrors are hiding in your electric bills?

UNDERSTANDING YOUR ELECTRIC BILL

The Basics—Usage & Demand

There is probably a very good reason why neither you nor anyone else at your company has ever looked closely at your electric bill—it is terribly confusing. Let's start with some basics. Almost every commercial user pays for two major components on their electric bill: **usage** and **demand**.

Usage is the more familiar component as it is the basis for your residential electric bill. It is based on the total amount of energy that you used over the course of the billing cycle (usually one month for commercial customers). Usage is measured in total kilowatt hours (kWh). Usage charges are based on some specific cost per kWh as defined in the rate schedule that applies to your utility account (more on rate schedules in a moment). Depending on the design of that rate structure, it could either be a fixed amount (that is, every kilowatt hour costs the same), a variable amount tied to when the energy was consumed (either time of day or time of year or both), or a variable amount based on levels, or tiers, of total usage.

Demand is a bit more complicated—it is usually defined as the greatest amount of power that the utility has to provide to you over a measured period of time during the billing cycle. For customers of California's Southern California Edison (SCE), demand is the peak power required during any 15 minute period over the month. That means that if your building has multiple HVAC units and they all come online during the same 15-minute window, your demand will spike much higher than it would if those units came on in a staggered fashion (since the power demand of an HVAC unit is highest when the unit is first started.) Demand charges are billed per kilowatt (kW) of power and, for many commercial customers, ***demand charges may account for more than half of your total bill!*** As with usage, how you are charged for peak demand depends on the design of your applicable rate structure. Demand charges might be a fixed amount per kilowatt needed, or it may be tied to the time of use, or even tiered.

Rate Schedules

Rate schedules, or *tariffs*, as they are known to electric utility regulators, are the formulas that a utility uses to calculate your bill. Every utility has a multitude of rate schedules that might apply to a commercial building[1] and you could pay vastly different amounts—that is to say you could save a lot of money—by switching to the most economical rate schedule for which you qualify.

Case in point: SCE has two rate structures that commonly apply to small to medium size commercial buildings: **GS-1** and **GS-2**. The beauty of the **GS-1** rate schedule is that it has no demand component. But here's the catch—your peak demand must not exceed 20 kW in

any three of the previous twelve months. Once you exceed the 20 kW demand threshold you are in the realm of **GS-2** which adds a substantial demand component. In fact, it adds two: one that applies only during the summer months (actually from June 1 to September 30) and a second that applies year round. That means that during the summer, you are paying for every kilowatt of demand—twice. Ouch.

We had one potential client whose bills revealed that they were paying under **GS-2**. When we analyzed their bills—the first step in preparing a proposal for installing a commercial solar power system—it was apparent to us that they were actually entitled to be billed under **GS-1**. When we met with their facilities manager to discuss our proposal, we pointed out that they ***could have saved over $2,000 the past year*** if they had been on the right rate schedule. We encouraged them to contact SCE about getting switched to **GS-1**. (No, SCE had not suggested that to them.) Strangely, none of the other solar companies that they had talked to had explained that to them, yet once they called SCE, they were switched over immediately.

Here's another example. One of the local municipal utilities in Southern California, Pasadena Water and Power (PWP), generally has low rates, but their mid-level commercial rate schedule (**M-1**) has one of the most significant "gotchas" we have seen anywhere—and we are yet to speak to a single potential client who was aware of this before we pointed it out. The **M-1** rate structure includes a demand component (denoted as a "distribution" charge), but unlike SCE's demand component described above, PWP charges you for the ***peak demand in any 15-minute window for the past 12 months!*** That means that if on one unlucky day,

everything in your building comes online all at once during the same 15 minutes, not only will you pay for that peak demand that month, you will pay for that peak demand for *every* month for the next year (unless a higher demand comes along to take its place). For one of our clients, they had a peak demand one month that spiked at 82 kW, yet their average for the next 12 months was only 36 kW. Under the M-1 rate schedule, they paid $5,300 more than they would have if they only paid for their monthly peak demand.

Gotcha, indeed!

Models Matter

One of the most important tools a solar company can offer its potential client is a properly designed and *up-to-date* set of rate schedule models that allows them to analyze accurately a company's prior utility bills. From that analysis it is then possible to make reasonable predictions regarding potential savings based on a host of measures: changing rate schedules, reducing usage or peak demand, ***and/or*** installing a solar power system.

Unfortunately, some solar companies simply assign a fixed amount of savings per kWh to their proposed solar power system's annual energy yield and call that your potential savings. Such an approach ignores the complexities of how your electric bill is actually calculated and may overstate the financial benefit of adding solar.

So before you pick up the phone, pick up your electric bills and check out what is hiding there—it is the first step in getting the greatest value from your commercial solar power system.

UNDERSTANDING NET METERING AND REBATES

Net Metering

In most grid-tied solar power systems, power from the utility's grid is provided at night and on cloudy days when electricity demand in the business exceeds the power generated by the system.

During the daytime when the power generated by the solar power system exceeds the local energy demand, the excess electricity is delivered to the utility grid thus "spinning the meter backwards." This is the concept of "net metering," whereby the excess energy you generate throughout the year offsets the energy you consume.

California law requires utilities (except LADWP) to pay owners of solar power systems for any excess energy that they produce. While most solar power system owners will not be net energy producers, this change in the law is an important step in making net metering agreements more equitable for system owners.

There is an alternative to net-metering, known as a Feed-in Tariff, that may be applicable to some commercial solar installations. Because Feed-in Tariffs are still rare in the United States (although they predominate in solar-friendly countries like Germany), we will postpone our discussion of them until Chapter VI. Special Cases.

Rebates

In most utility regions, owners of commercial solar power systems are paid a rebate directly from the utility. A solar rebate is an assignable payment to the utility customer as an incentive for installing the sys-

tem. These rebates are typically funded by a special fee assessed on electric bills such as a "public benefit" charge.[2]

Regardless of the source of funding, there are two generic types of rebates used by utilities: Expected Performance Based Buydown (EPBB) and Performance Based Incentive (PBI).[3] While different utilities may offer one or both types of rebates, for any given system only one type of rebate will be allowed.[4]

EPBB Rebates

The EPBB rebate is a one-time, lump-sum payment based on the ***expected*** (as opposed to the measured) production of the solar power system. An EPBB incentive is generally limited to residential and small commercial/non-profit/government installations of 30 kW or less.

These rebates are calculated based on the anticipated output of the system. In California they are typically based on what are known as CSI (for California Solar Initiative) AC Watts. To determine that value, the CSI rebate calculator is used, and its calculation takes into consideration the performance characteristics of the equipment selected (*i.e.*, PTC[5] rating of the solar modules and the efficiency rating of the inverter(s)), the azimuth and pitch of the array(s) (which determine the array's orientation toward the sun), the geographic location of the system site, and any shading factors that might affect the system's anticipated performance.[6]

EPBB rebates are a good deal for system owners since they provide all of the rebate money upon commissioning of the system. However, they are a decidedly less beneficial arrangement for the utility,

particularly for larger systems. Since EPBB rebates are not tied to actual performance, the utility pays the same rebate for under-performing as well as over-performing systems.

PBI Rebates

PBI rebates are intended to overcome those problems and insure that the utility is not providing an incentive for systems that fail to meet expectations, or don't operate at all. A PBI rebate typically consists of five annual payments based on the actual performance of the solar power system. PBI rebates are calculated based on a fixed price for energy produced, expressed in cents per kilowatt hour, in a similar way to how usage is calculated on your electric bill. As a result, the more energy the system produces, the higher the rebate. Unfortunately, if the system does not live up to its projected annual production, the system owner will have the unpleasant surprise of receiving a lower than expected rebate.

In some cases, utilities will allow a customer to opt into a PBI rebate if their system size is in a certain range, frequently between 10 and 30 kW, but generally all systems above 30 kW will be required to receive a rebate under the PBI method.

One important difference with a PBI rebate is the need for an approved performance monitoring system so that the utility (along with the customer) knows exactly how much energy the solar power system is producing each month, since that is the basis for the rebate payment. The complexity of that monitoring system can vary widely, from simply installing a revenue-grade meter (that is, a meter that measures energy production to the utility's specified tolerance,

such as ± 0.2%), to a complete remote monitoring and reporting system supplied by a third-party vendor.

Since the utility only pays for power actually delivered, rebate dollars are guaranteed to provide the bargained for benefit. However, because of the potential need to supply the utility with verified performance data, PBI rebates may increase the Operations & Maintenance (O&M) expense of a commercial solar power system, at least for the five years of the PBI rebate. On the other hand, if your system is well maintained and conservatively designed, you may actually receive more in rebate payments than originally projected.[7]

UNDERSTANDING TAX INCENTIVES

Federal and state tax incentives are another important concept to understand in the economics of a commercial solar power system. Although a detailed discussion of the tax incentives available to a particular project is a topic beyond the scope of this book, there are two broad classes of tax incentives that will apply to most commercial solar power systems that are purchased by for-profit entities: the federal Investment Tax Credit and Accelerated Depreciation.

Federal Investment Tax Credit

The federal Investment Tax Credit (or "ITC") provides a full 30% of the direct cost of the solar power system in the form of a tax credit to the entity that owns the system. The applicability of the ITC to indirect costs—such as deciding to re-roof your building before adding solar—must be decided on a case-by-case basis.

Since commercial rebate payments are generally treated as taxable income for a commercial building

owner, the value of the rebate is not deducted from the system cost when calculating the basis for the rebate. (This is the opposite of what typically occurs for a residential solar client since residential rebate payments are generally not taxed; hence, the value of the rebate must be deducted from the system price in calculating the basis for the ITC.)

Since the ITC is a one-for-one reduction in the amount of tax actually owed, it is possible that it might exceed the system owner's tax liability in the year that it is earned. Fortunately, IRS rules allow the excess credit to be carried backward one year (by filing an amended return for the previous year) and forward up to twenty years.

The ITC is scheduled to step down from 30% to just 10% starting in 2017.

Accelerated Depreciation

Another important tax incentive is depreciation, by which a taxpayer can deduct the cost of purchased equipment against their net income. As this is written (Summer 2013), federal law allows an accelerated depreciation schedule to be applied to solar equipment, and some states—such as California—do as well.

Since depreciation reduces the taxpayer's adjusted gross income, its cash value is dependent on the taxpayer's overall tax bracket. However, for high-income taxpayers, depreciation can significantly reduce the overall cost burden of adding solar.

As these can be very complicated questions to answer, please consult with your tax advisor for the specifics that might apply to your situation.

Chapter Notes

[1] See, for example, the tariff page of the SCE website which lists some twenty-two Commercial rate structures, each of which contains multiple sub-types. https://www.sce.com/wps/portal/home/regulatory/tariff-books/rates-pricing-choices/business-rates, accessed 6/2/2013.

[2] In California, public benefit charges are used to pay for a variety of utility programs, including rate reductions for customers on fixed-incomes.

[3] A database of rebates for solar power systems nationwide, compiled by North Carolina State University, is available at the DSIRE website, http://www.dsireusa.org/, accessed 6/2/2013.

[4] Some utilities will allow the system owner to elect which type of rebate they will receive.

[5] PTC stands for **P**hotovoltaic **T**est **C**onditions and is meant to indicate the "real world" power output of the tested solar module. As a result, it is always lower than the nameplate rating of the module.

[6] For more information about how the various equipment and environmental factors cited here affect the performance of the system, see Chapter III. Moving Forward: Comparing Contractors & Their Bids - Apples to Apples, p. 29.

[7] As was the case for the system installed at Westridge School for Girls. See Chapter VII. Lessons Learned: Reporting from the Rooftops - Second Case Study: Westridge School for Girls, Pasadena, California – The Beauty of Doing it Right, p. 117.