The Customer's Guide to Solar Power Purchase Agreements

October, 2008
A Rahus Institute Publication

the Rahus Institute

Solar power, without the upfront cost

FOR ORGANIZATIONS AND BUSINESSES

First Edition: October, 2008

Customer's Guide to Solar Power Purchase Agreements

Guide description

The Customer's Guide to Solar Power Purchase Agreements is for organizations that would like assistance navigating purchase and contract decisions as they move to host solar power systems. We prepared the Guide for a broad audience, including businesses, government agencies, public institutions such as school districts and non-profits. This project is made possible by solar services providers who believe an educated customer is their best business partner.

Acknowledgments

We are most thankful to our advisory and editorial committees for their outstanding contributions and for sharing their expertise. In addition, thanks to Robert Martin from the San Diego Unified School District and John Supp from the California Sustainable Energy Center for their insights.

Authors

Liz Merry, Verve Solar Consulting, author and editor
Elisa Wood, RealEnergyWriters.com, co-author
Catherine Paglin, proofreading

Sponsors

Anaheim Public Utilities, City of Palo Alto Utilities, City of Lodi Electric Utility Department, Energy Trust of Oregon, MMA Renewable Ventures, Rahus Institute, Solar Power Partners, SunEdison.

Core references

Below are some of the core resources used in drafting this guide.

- "Guide to Purchasing Green Power," Green Power Partnership, September 2004.
- "Solar Power Services: How PPAs Are Changing the PV Value Chain," executive summary, GreenTech Media, February 2008.
- "Solar Photovoltaic Financing: Deployment on Public Property by State and Local Governments," National Renewable Energy Lab, May 2008.
- "Power Purchase Agreements: The New Frontier," forum held at Solar Power 2007 conference, September 2007, Long Beach, California.

the Rahus Institute
Solutions for a Sustainable World

SOLAR POWER PARTNERS

california solar center

MMA Renewable Ventures

EnergyTrust of Oregon, Inc.

SunEdison
simplifying solar

Chapter 1
Is solar power right for our organization?

Introduction

This Guide is designed to help your organization join the rapidly growing number of school districts, businesses, and government institutions that now use solar electricity. We suggest factors to consider and questions to ask as you work with staff members, solar vendors, and other experts who will help you make the transition to clean energy.

Here you will find detailed information on the increasingly popular Solar Power Purchase Agreement, a contractual arrangement that minimizes your upfront costs for solar electricity. We also offer you guidance in securing incentives, lowering costs, and navigating renewable energy certificate markets. We discuss other ownership and lease options and when they might be the best choice. And finally, we supply real world success stories.

The Guide focuses solely on grid-tied photovoltaic (PV) technology, which produces electricity from sunlight for customers connected to the local utility grid. These systems reduce, rather than completely replace, the power you now receive from your electric utility. We distinguish these systems from off-grid solar, which is not paired with back-up electricity from the local utility.

You are adopting a technology that is growing quickly in the United States -- more than 48 percent annually since 2000 (Figure 1). This impressive expansion comes as the cost of electricity from traditional sources increases, and solar technology matures worldwide.

Capacity of Annual U.S. Photovoltaic Installations (2000-2007)

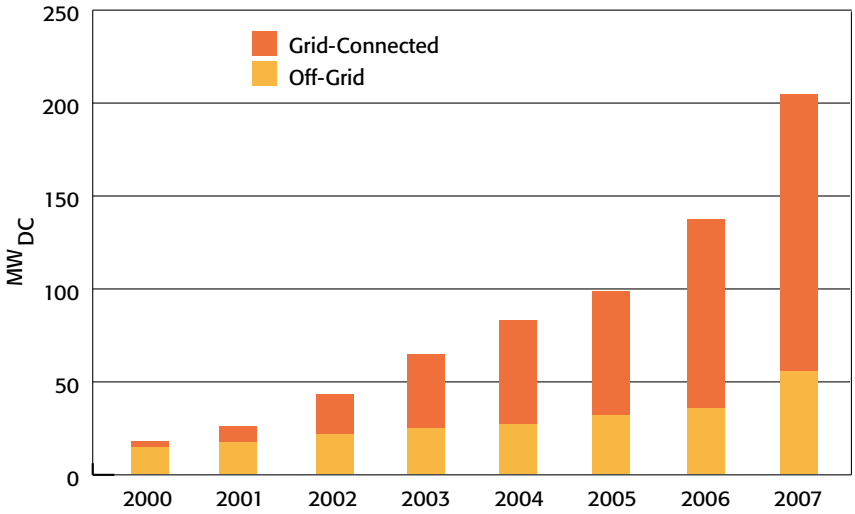

FIGURE 1
Data from "U.S. Solar Market Trends 2007," Larry Sherwood, Interstate Renewable Energy Council

Today's solar industry

Today's solar technology is highly reliable, safe, and backed by strong equipment warranties based on solid field-testing data. Customers can find dependable, well-trained solar installers who have provided systems for organizations including major universities, retailers, hotels, and government entities. By the end of 2007 more than 43,000 grid-tied solar electric systems operated in the United States, producing enough electricity for close to 500,000 homes. More solar electricity is added daily, as the cost of utility power rises and customer awareness grows. If financial support for solar incentives you should seriously consider using solar power.

Below we list some of the benefits of an on-site solar installation, as well as challenges that may occur in particular circumstances.

Benefits

- Provides a predictable cost for electricity over the life of the system
- Makes clear to the public your environmental commitment by producing clean electricity at your facility
- Offers flexible expansion if your needs change
- May support the local economy and generate new jobs
- Produces back-up power in a blackout if storage capacity is added

Challenges

- Not all regions have access to financial solar incentives
- May require a high upfront investment if the equipment is to be purchased directly
- Requires monitoring over the life of the system to ensure proper production
- Involves planning and project management
- Requires owners to retain renewable energy certificates associated with the system in order to make certain environmental claims (See Chapter 3)

If you are not familiar with solar technology, please review Appendix 1 to learn how these systems work.

Chapter 2

What is a Solar Power Purchase Agreement (SPPA) and how will it benefit us?

The Solar Power Purchase Agreement (SPPA) is an alternative to financing and owning the system. It offers you an opportunity to install solar power at your facility without paying upfront costs or worrying about system operation and maintenance. Sometimes referred to as a "third party" ownership model, this approach lets you focus on your core mission, while solar experts manage your energy system. For 15 to 20 years, you enjoy predictable, pre-set electricity prices, and power from a solar system that is a source of pride for your organization.

Power purchase agreements are a well-established contract mechanism. Many large businesses, such as Kohl's and WalMart department stores, and institutions, such as airports and water districts, use these agreements for buying solar electricity. Those familiar with the power industry will find an SPPA is much like the traditional "power purchase agreement," a common contract between utilities and large centralized energy plants. Because SPPAs represent a good investment opportunity, major investment firms such as Goldman Sachs and Morgan Stanley provide financing to these projects.

As you consider the benefits of an SPPA, we also want you to know there are other ways to buy solar generated electricity. For example, you might buy your system

Benefits to you of an SPPA

- Demands no upfront expense in order to buy solar power
- Provides predetermined electricity rates for term of contract, typically about 15 to 20 years
- Offers production monitoring and metering by experts
- System owners take responsibility for operation and maintenance of equipment
- Supports renewable energy industry and local jobs (for installation and maintenance)
- Offers possible path to meet your green policy objectives
- Places emphasis on ensuring maximum productivity of solar system
- Option to purchase the system at fair market value after set time period

Challenges

- Demands more complex negotiations and possibly higher transaction costs than buying system outright
- Creates potential conflict between your desire to achieve green policy goals and save money on electricity
- Ongoing administrative costs of paying separate electricity invoices, and allowing accesss to equipment by maintenance personnel
- The SPPA will be owned by a special purpose entity that may have limited liability and limited assets, and the SPE parties may change over time
- The host customer may be prohibited from making changes to property that could affect the solar production

> *"I'd put my money on the sun and solar energy. What a source of power!"*
>
> Thomas A. Edison, 1931
> in a comment to Henry Ford

outright. Ownership requires financing up front, and the ability to monitor the system production and maintain the equipment. You might finance your system with a lease. In a lease-to-own financing agreement you typically make no, or little, down payment, and purchase the system with fixed monthly payments over time. Or, finally, you may have access to a green power program that allows you to buy renewable electricity directly from your utility.

Both the SPPA approach and system ownership offer great benefits, and some challenges. We describe the power purchase option first so you can compare it against the other options which are described in Chapter 5.

Whatever method you choose, once you install solar energy generating equipment, your organization joins the growing number of wise energy consumers who generate their power from sunshine, a fuel source that is clean and always free.

Terms to understand

Kilowatt (kW): A unit of measure for the amount of electricity needed to operate given equipment. Equals 1000 watts.

Kilowatt-hour (kWh): The most commonly-used unit of measure indicating the amount of electricity consumed over time. It means one kilowatt of electricity supplied for one hour.

Megawatt (MW): Equals 1,000 kW or 1,000,000 watts. According to the California Independent System Operator, one megawatt of utility supplied power is enough electrical capacity to power 750 average homes.

Parameters for a good SPPA project

The ideal SPPA project involves customers who:

- Use large amounts of electricity, generally more than 200,000 kWh annually
- Control their property
- Demonstrate credit-worthiness
- Offer a minimum of 10,000 square feet of unshaded space for installation
- Are located in a region with pro-solar policies and incentives

Circumstances vary from project to project, and region to region. The preceding criteria are usually necessary for an SPPA project to go forward.

The SPPA structure

Your organization contracts with a solar services provider that is responsible for financing, designing, installing, monitoring, and maintaining your project. You do not pay for the installation, but instead buy the electricity the system generates. You make your payments to the solar services provider for the electricity the solar system produces, just as you now pay your utility for electricity from large central power plants (Figure 2).

You determine the level of payment in advance, so you know what your power costs will be over the life of the SPPA contract, usually 15 to 20 years. In this way, SPPAs offer very different terms than utilities. With the permission of regulators, your utility increases your electricity rates at any time. Many believe that electricity rates will rise significantly as climate change legislation is adopted because most electricity in the U.S. is produced from carbon-intensive fuels, such as coal and natural gas. So it is difficult to predict your future energy costs when you buy power from a utility. SPPA contracts avoid unexpected price fluctuations because the cost of the fuel is known: sunshine is always free.

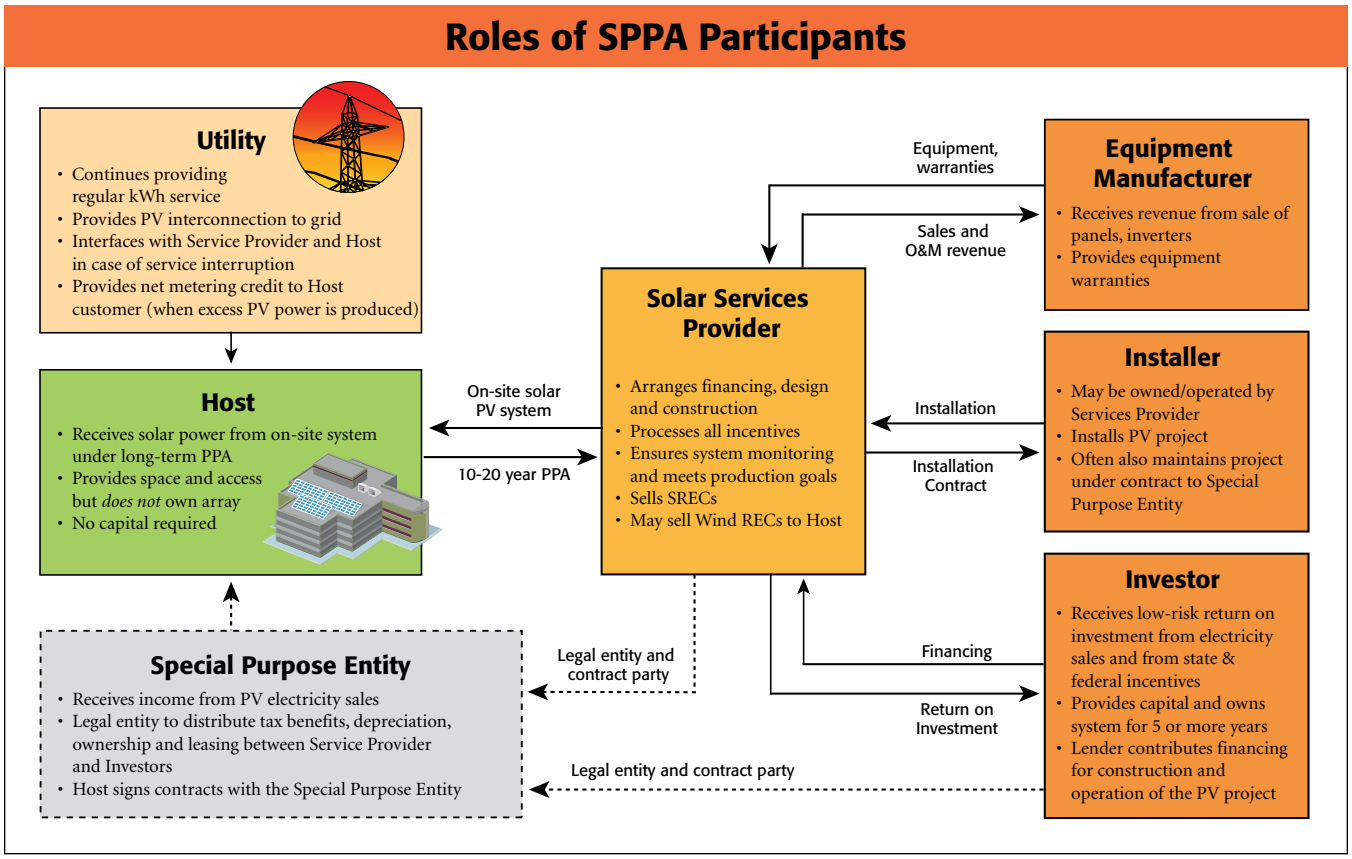

FIGURE 2

The SPPA participants

Four entities play a role in your contract agreement, either directly or indirectly. To help you understand how this method works, here we outline who they are and what they do.

Solar Services Provider (SSP): This is the project coordinator, the company that you will hire to make your project happen. An expert in financing with strong connections to investors, the SSP knows about installation and monitoring of equipment, and completes your project on time and within budget. The SSP either owns or contracts with a system installer who works with you on system design, equipment, metering, and production monitoring and maintenance.

These providers try to keep transaction costs to a minimum for the entire project so they can offer you a competitive electricity price and their investors a reasonable rate of return. With that goal, the solar services provider will offer your organization a "standard offer" agreement that describes the most common terms for your type of organization.

Some solar services providers are aligned with particular manufacturers, while others are technology neutral and work with various manufacturers. The SSP will make a priority of using the right equipment for the job.

> *"Power purchase agreements have been the cornerstone financing tool for utility scale projects for decades."*
>
> Wally McOuat, Principal, HMH Resources

Investor and Special Purpose Entity: The solar services provider engages financing partners. A lender, usually a bank, may fund the construction of the solar system and also provide a long term loan to the project. The investor or group of investors provides equity financing and receives the federal and state tax benefits (called "tax equity" investing). You may not work directly with the financing partners, but it is useful to understand their requirements and relationships to ensure your project has solid financial backing.

The investors and solar services provider form a special purpose entity to own the solar electricity system and allocate tax credits and other benefits and risks. A reputable solar services provider will attract stable lending and investment partners, who in turn are eager to work with host customers that have a strong credit rating.

The special purpose entity is the legal entity that you will be dealing over the long-term, and it receives your payments for the solar kWh.

Host customer (you): As host customer, you agree to install the solar electricity system on your property, work with the solar services provider to enable efficient project installation, pay for all of the electricity the system produces at the negotiated rate, and provide access to the system for monitoring and maintenance. Depending on the terms of your agreement, you may purchase the system at fair market value when the contract ends. In some cases this may be as soon as six years after the system was installed.

Utility: The utility and its treatment of solar electricity is an important factor in the project, especially given that the solar equipment may, at times, produce more power than what is being used on-site. Utility policy will affect project timing and whether or not you purchase the system at the end. In the next chapter, we will explain the utility role and why you will want to learn about interconnection agreements, net metering, incentives, peak demand, demand charges, and other elements of your relationship with your utility.

Summary

The solar power purchase agreement is becoming a very popular option for buying solar electricity in the U.S. In this model a project developer, known as the solar services provider, brings an investor and host customer together to install a PV system on the host's site. The PV electricity reduces the amount of electricity that must be purchased from the local utility. The utility supports the project by connecting the solar equipment to the grid and providing credit for any solar power sent back through the meter to the grid.

Now that you have a basic understanding of the roles and responsibilities of the SPPA project participants, we move on to describe the utility policies required to support your solar project.

> ***"Lenders have this particular relationship to risk, which is…. they don't take any."***
>
> Morten Lund, Partner, Foley & Lardner LLP

Chapter 3
Utility support & financial considerations

To get started on your SPPA project, you will need to research how your utility treats solar electricity installations. This chapter describes how to gauge your current energy costs, how solar systems are connected to the utility grid, how the excess solar electricity is credited, and how to value the renewable energy certificate (REC), which is a financial tool that captures the "green" values of the solar power.

Researching your projected electricity costs

Your local utility may help or hinder your plans to install solar energy. We encourage you to thoroughly investigate pertinent rules, tariffs, and incentives offered by your utility. State rules and utility policies vary dramatically throughout the nation, so it is important that you understand your local situation.

To calculate the value of your solar electricity system you should understand what you are paying now, and what you will be paying for kWh in the future. While it's impossible to predict exactly, your utility can provide price projections for your organization. The Energy Information Administration, a division of the U.S. Department of Energy, is also a good source of electricity price forecasts (See Resources).

Interconnection

It is federal policy that utilities accept interconnection of a solar power system to their grid. The contract between the system owner and the utility is called an interconnection agreement. This agreement includes the conditions, equipment requirements, and process for connecting to the grid. While your utility has a well-defined process for connecting centralized energy plants that feed electricity to many customers on the utility grid, they may not have a process for smaller on-site solar projects. To help minimize project costs, it is important you have a streamlined process to connect to the grid. Check with your utility to learn how it may support or restrict connecting your solar project.

Net metering

In addition to allowing interconnection to the grid, many utilities will credit you for the electricity you do not use from your solar project. This arrangement is called net metering. Net-metering regulations include provisions for:

- The amount of electricity that can be sold to the utility
- The rates at which the utility will buy it
- An ending date for the agreement (in some cases)

Your utility may have a cap on the total amount of net-metered electricity that it will purchase from you. Or the utility may credit you at a very low rate for the excess solar electricity. Such caps can be deal breakers for customers seeking cost-effective solar electricity.

Solar is most valuable when the net-metering agreement allows for at least retail compensation (the price customers pay), and gives you the opportunity to earn enough credit to entirely offset your energy bill over the course of a year.

Understanding your net metering options is key to measuring the financial benefits from an on-site generation project that will "make the meter spin backward." If your project

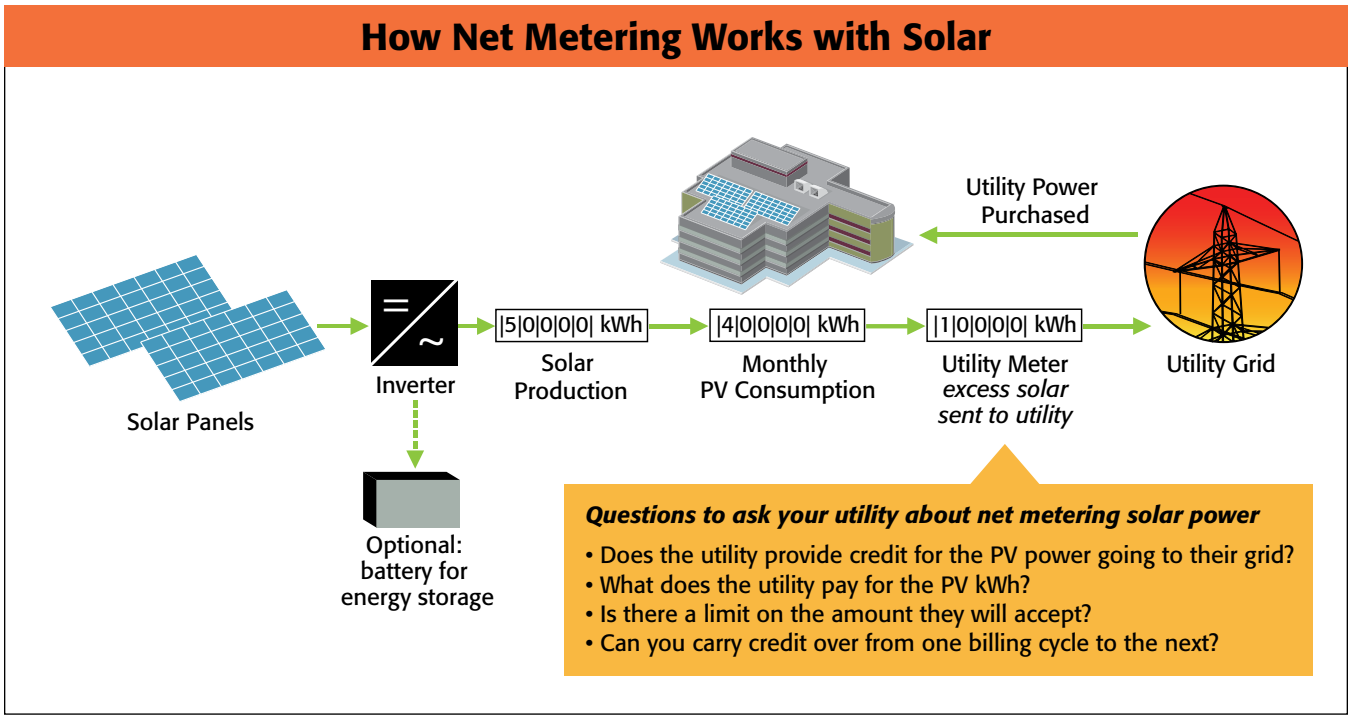

FIGURE 3

is sized such that you will never export power to the utility, net metering is less important (Figure 3).

Nearly all the states have some form of net metering rules (Figure 4). Depending on their consumer-friendliness, the rules can provide you with a significant credit toward your energy bill. Net-metering is so named because it refers to the number of kWhs you buy from the utility minus the amount you export to the grid. You pay for the difference or "net" amount.

Example of how net metering works with solar:

100,000kWh	electricity purchased from utility before the PV system, then PV system installed
- 40,000kWh	PV electricity used directly
- 10,000kWh	PV electricity exported to utility and credited to your account
50,000kWh	"net" amount you buy from utility after PV system installed

Time-of-use rates

The time-of-use (TOU) tariff recognizes the added value of electricity during peak usage periods when utility operators have to invest additional resources to meet the high demand for power. With a time-of-use tariff the customer pays a premium price for electricity during peak hours, and less for power other times. This pricing scheme can greatly enhance the economics of a green power project, particularly if your organization can manage its energy demand by using very little power during the peak demand periods, for instance on summer afternoons.

If your utility provides full retail credit for the solar electricity you send back into the grid, and you are on a time-of-use agreement, you may be able to sell your PV power at the highest rates (e.g., 38 cents/kWh), while buying power from your utility at off-peak rates (e.g., 10 cents/kWh) at night when your solar panels stop producing power. This financial scenario depends on your ability to limit the amount of power you use during peak periods, and your PV system consistently making the meter spin backward during these key hours.

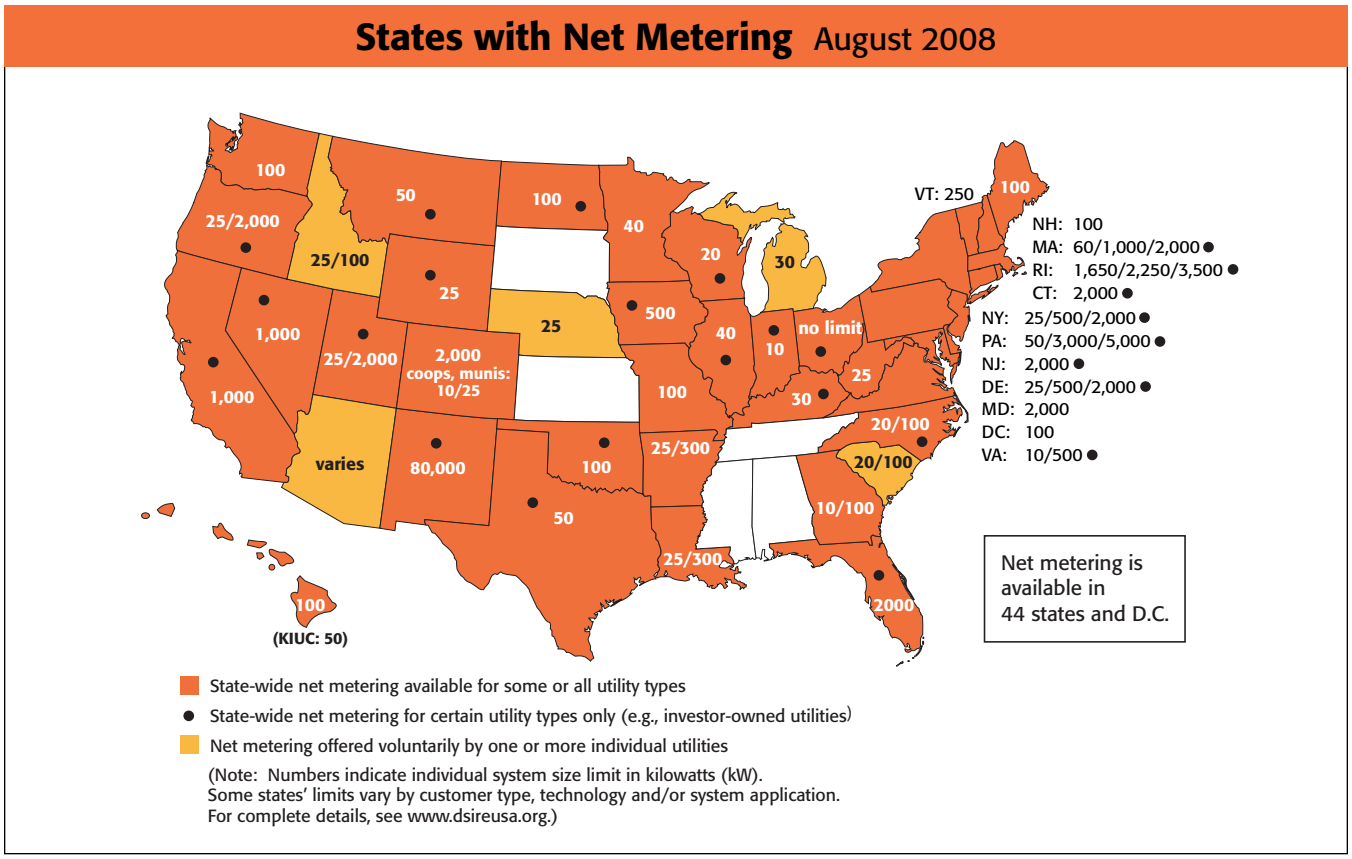

FIGURE 4
Data provided by DSIREUSA.ORG

Renewable portfolio standards

Many states require utilities to provide a certain amount of renewable power in their electricity mix (Figure 5), which is known as a Renewable Portfolio Standard (RPS). It is expected that the federal government will eventually adopt a minimum standard that all states will have to meet. A few states specifically require that solar energy make up part of the renewable energy mix. This is known as a solar set aside. Some of these states allow utilities to meet this requirement through a solar incentive mechanism known as solar renewable energy certificates (SRECs).

Solar renewable energy certificates (SRECs)

Renewable energy certificates (REC's) are a financial trading mechanism that define the renewable energy attributes of electricity independently from the electricity itself (Figure 6). In this way the "renewable" value of the power source can be monetized, and a market for these attributes can be created. A REC represents one megawatt hour of electricity produced from a renewable energy source, such as solar system or wind turbine. The majority of these certificates sold in the United States are generated by wind turbines, but the number of solar RECs, or SRECs, available is increasing each year.

In some states SRECs are used as the incentive mechanism to promote the use of solar power. This is known as a "compliance market." In these areas the utility is buying the certificates from your system in order to meet their RPS requirement.

If you are not in a compliance market, there is a voluntary market for the SRECs. This market is where customers (e.g. Intel Corporation, PepsiCo, Whole Foods Market, and even individuals wanting to "green" their own power supply) purchase SRECs in order to claim that their energy supply is produced by renewable power. FritoLay, for instance,

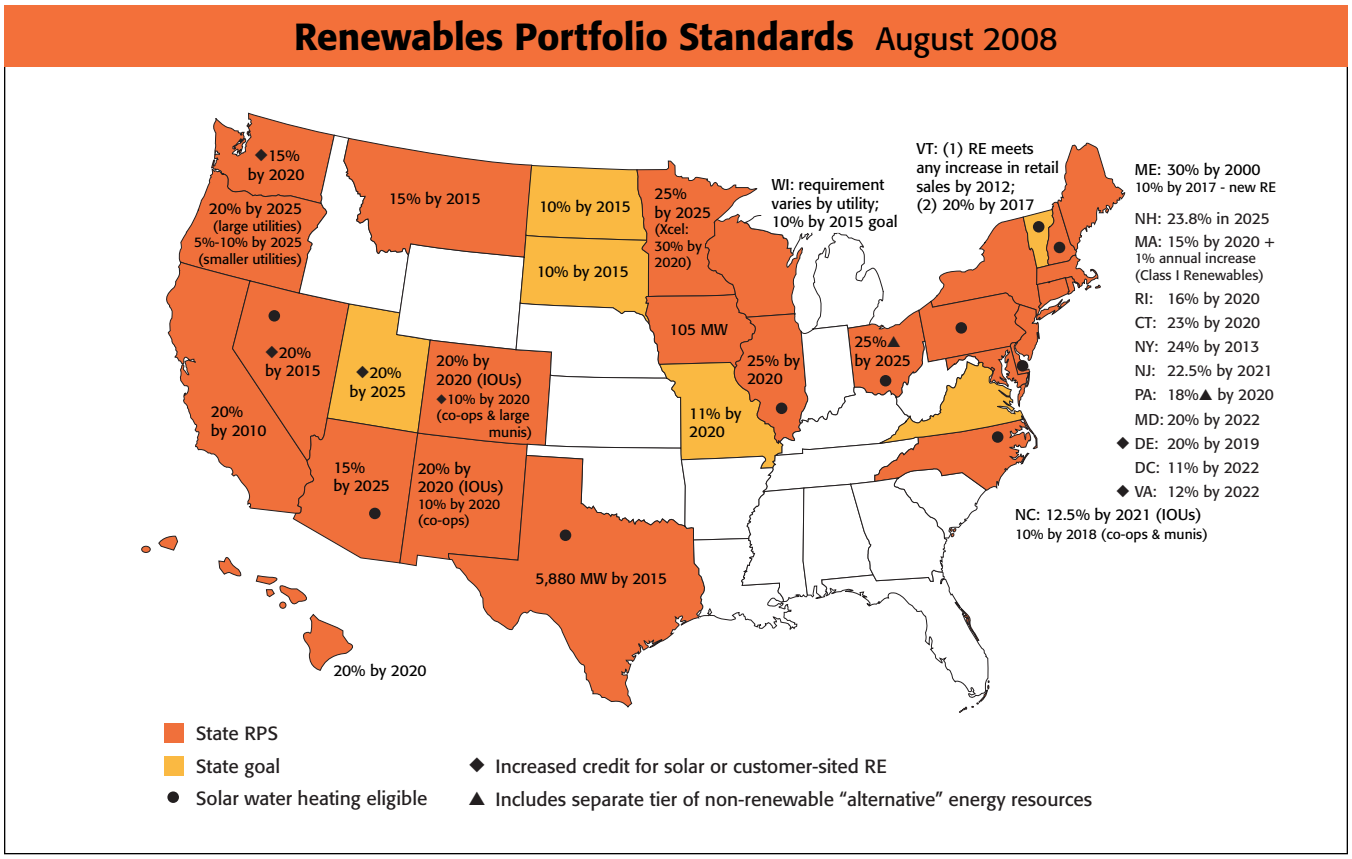

FIGURE 5
Data provided by DSIREUSA.ORG

has purchased enough SRECs to state that their SunChips snack product is "powered by the sun." The solar system equipment owners who sold their SRECs to FritoLay still use the actual electricity coming from their solar equipment. However, they are not entitled to make claims or treat the electricity as coming from a solar energy source. For a list of companies using SRECs to green their power supply visit the Green Power Partnership website (See Resources).

In a voluntary market you must own the SRECs produced by your PV system in order to claim use of solar power. Only the SREC owner can cite use of solar in marketing materials and to meet policy goals.

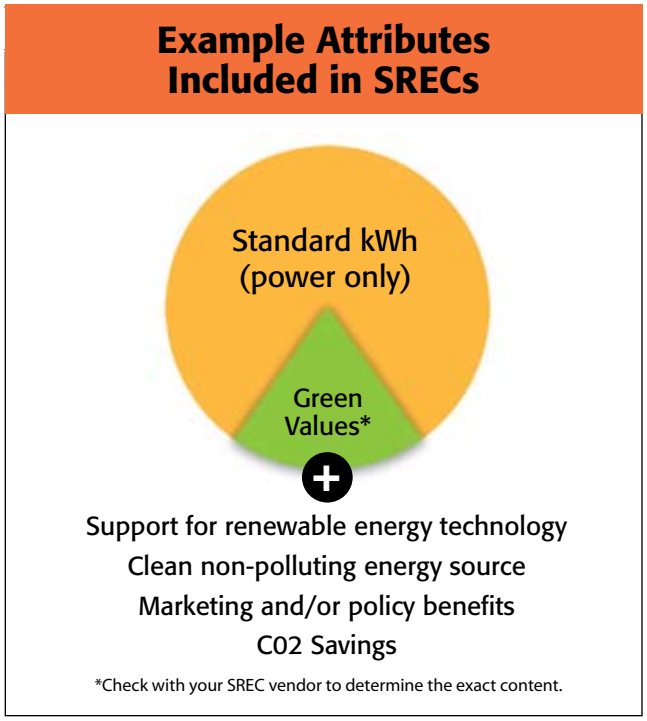

FIGURE 6

Green-E, to certify your SRECs and ensure their legitimacy (See Resources).

If you choose to keep your SRECs, you in essence retain the ability to claim the environmental bragging rights to your project. SRECs tend to be more expensive than wind RECs, but they provide the opportunity to make an attractive marketing statement, such as: "This facility is powered by the sun." So, if your organization is trying to meet an environmental objective, SRECs will be particularly important to you.

Benefits of buying solar power without SRECs

If you want to lay claim to the environmental benefits and meet your organizational policy goals, you might be able to purchase the SRECS from the system owner as part of your SPPA contract negotiations. The price you pay the PV system owner may be less than the value of the SRECs in the voluntary market.

The value of these certificates in the voluntary marketplace varies dramatically by state and changes over time depending on supply and demand. State and federal policy support for solar power also has a dramatic effect on the value of SRECs. Below is a market snapshot from mid-2008.

REC prices July 2008

	Wind*	Solar*	Region
Voluntary market	$4.25 per MWh	$10 per MWh	National
Compliance market (RPS requirement)		New Jersey $280 per MWh depending on state program	Varies by state

*As reported by Evolution Markets - See Resources. Price offered, not bid price. Divide MWh by 1,000 to find kWh price.

Your solar system power without the SRECs is still preferable to utility-only power in many respects:

- Your price for the solar electricity is known over time; utility rates are uncertain and likely to rise.
- You support local jobs and the renewable energy economy.
- Because your solar electric system is most productive during peak demand periods, you help reduce stress on the grid, which may, in turn, lower utility costs and reduce the risk of blackouts.

Top 10 states for cumulative grid-tied PV installed through 2007:

California
Nevada
New Jersey
Arizona
Colorado
Hawaii
Delaware
Vermont
Connecticut
New York

Data from "U.S. Solar Market Trends 2007," Larry Sherwood, Interstate Renewable Energy Council

Summary

To assess the economic proposition for your solar project you want to understand your energy budget over the long term. You can research projected electricity prices through your utility and the federal government provides projections as well.

Your utility's pro-solar interconnection and net metering policies make the SPPA project possible. Also, your state's renewable portfolio standard may dictate how the utility treats solar and whether SRECs are used as an incentive mechanism.

States with pro-solar policies — including California, New Jersey, Nevada, Arizona, Colorado, Maryland, and Hawaii — are most fertile for SPPA projects. Support for installing solar PV is increasing rapidly throughout the United States, and the North Carolina Solar Center maintains a comprehensive resource for researching your regional solar policies and incentives — Database of State Initiatives for Renewables & Efficiency, which can be found at dsireusa.org.

Chapter 4
Steps to a successful project

Below we outline the most basic steps necessary to move forward with an SPPA. We take you from an initial analysis of your energy use through finding your solar services provider, securing the contracts, and getting your system installed. You will find detailed contract information in Appendix 2.

Step 1: Research current and projected kWh costs

This is the same first step for all energy projects. You need to know what you spend now on kWh, to assess what you will save through the solar energy project. The state-by-state average price per kWh is shown in Figure 7. Review your utility bill for your electricity rate.

If you don't have in-house energy professionals who understand the complexities of utility tariffs you may want to work with a consultant who assists with the project and represents your interests in contract negotiations.

This investigation should be fairly comprehensive, and we can only list a few of the initial questions to address here. These are listed from the broadest organizational issues to specific utility treatment of solar:

- How does solar fit into your long-term business plan?
- Can you commit an installation location for 20 years or more?
- What is the condition of the installation site?
- Do you plan to expand your business or greatly increase your use of electricity? Does your utility support the connection of solar equipment?
- What credit do they give solar power sent to the grid?
- What is your electric load profile and what impact will solar have on it?

An experienced energy consultant can help guide you through the SPPA project. Customers sometimes hire energy consultants to:

- Confirm and verify that the project is feasible
- Identify issues and propose solutions
- Provide technical and economic expertise about solar projects
- Offer detailed knowledge (lessons learned) from other projects that may inform your choices and understanding of the current SPPA market conditions

However, in addition to the cost of contracting for these services, your project staff should work closely with the consultant, and will still need to work directly with the solar services provider to implement the project.

Step 2: Assess energy efficiency measures and costs

Before you install a solar energy system, we suggest you analyze your current energy profile to uncover ways you can reduce electricity use. You can save electricity by adopting energy efficiency and conservation measures.

Cutting back on your energy consumption is the best way to save money and advance clean energy goals. Efficiency savings are most easily found in lighting, the building envelope, heating and cooling units, and other energy intense equipment, such as water and pool pumps, or any device drawing power 24 hours a day.

Conservation plans (i.e. changing the behavior of the facility users) can be a major source of energy savings too. Some solar services providers can assist you in this area through their energy efficiency business units.

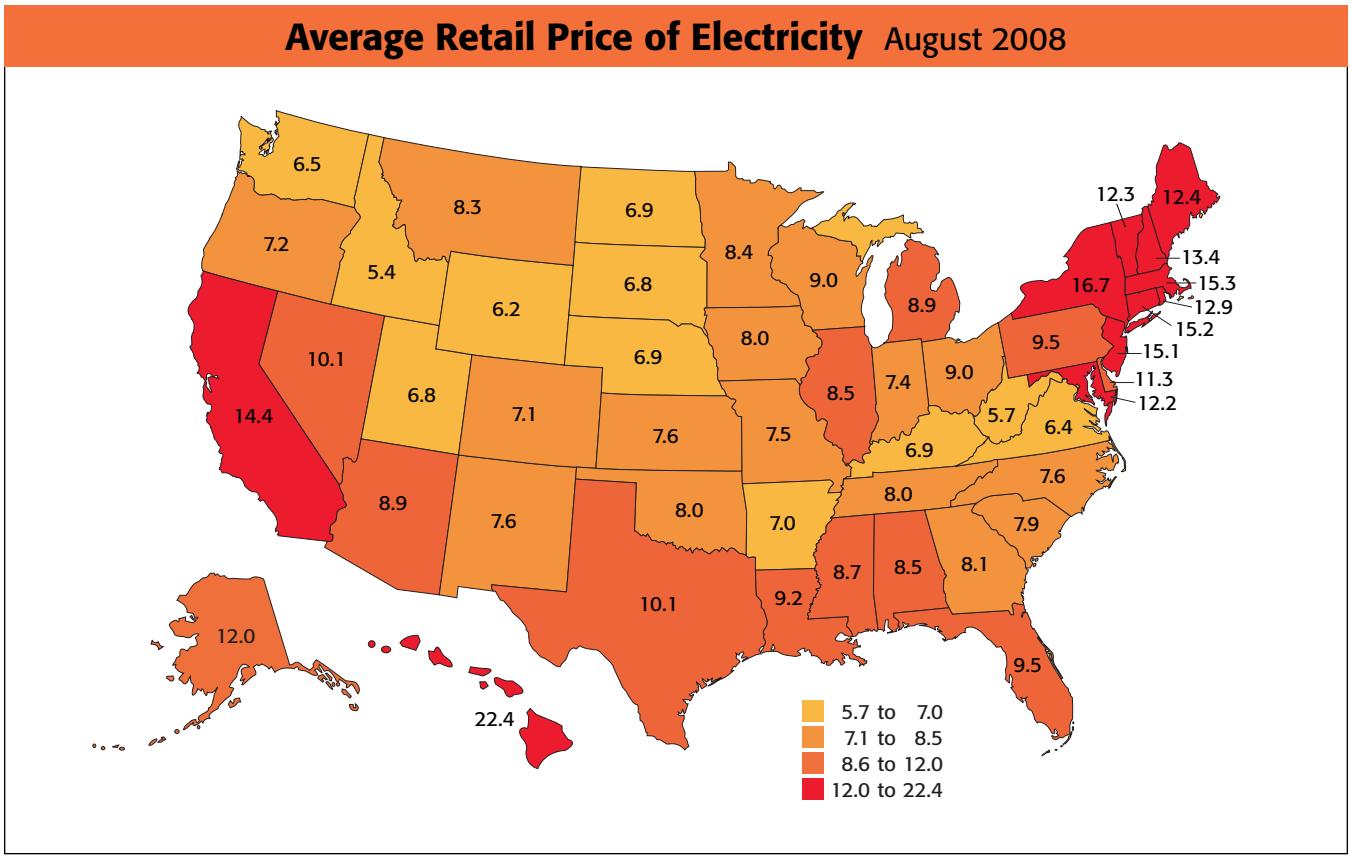

FIGURE 7
Data from the U.S. Energy Information Administration

Step 3: Identify possible installation locations

It is a shame to spend countless hours considering energy budgets and potential solar electricity costs if there is no place to install the equipment. For an SPPA project to proceed efficiently, you must know where it will be installed. From the beginning you want to account for the cost, if the project requires a roof replacement or any other new structure to support the solar panels.

To be cost effective your SPPA project will usually be larger than 100 kW. A solar system this size requires at least 10,000 square feet, whether on a roof or parking structure, or mounted in a field. While a single large system is easiest to install, your organization may be able to provide multiple installation sites for an aggregated project (e.g., five buildings with 20 kW each).

The ideal installation location is sturdy and unshaded with full access to south or southwest-facing sunlight. If your roof is due to be replaced within five years it may be ideal to combine the solar project and roofing project. This can substantially lower solar installation costs.

Step 4: Find a solar services provider

When you are ready for an SPPA, call the solar services provider first. The solar services provider has relationships with qualified solar installers. In some cases the solar services provider has its own installation staff or business unit.

This is a fast-changing market with few barriers to entry. So you want to hire a solar services provider with a solid reputation in handling SPPAs. We recommend that you choose professionals who have experience with successful projects, to avoid investing your time and budget on their learning curve. Solar electricity systems last a long

time, and power purchase agreements are typically 15 to 20 years. So your relationship with your solar services provider is like a marriage—you want someone who will be around for the long haul.

Solar services providers are commonly found through a Request for Qualifications (RFQ) or Request for Proposals (RFP). The RFQ generates a short list of contractors who meet the standards you seek, and the RFP generates a more detailed bid for your specific project.

At CaliforniaSolarCenter.org we have posted web links to several examples of RFPs, SPPA contracts, and an RFP template developed by the Prometheus Institute for Sustainable Development.

What makes a good solar services provider?

The company should offer:

- A track record of accomplishment with this kind of transaction.
- Personal references that show experience working with solar electricity systems similar to yours.
- Financial partners with the substance and sophistication to follow through with the deal.
- Installation expertise and knowledge. Be sure the solar services provider works with experienced installers who have built a system under SPPA terms. The installer may continue to work closely for many years with the solar services provider to ensure the system produces as expected.
- Contract flexibility to support your needs. (But recognize that changes you make to the standard contract raise transaction expenses, potentially increasing your price for solar electricity.)
- Monitoring and production reports and feedback. You pay for the power they say the system is producing, so you want to know exactly what you purchased.
- A defensible savings analysis. Is the company using the proper tariffs in its calculations? Is it providing realistic assumptions about your system's electricity output. Inflating output is the number one "fudge factor" used to exaggerate the benefits of solar electricity.
- The ability to provide the best equipment for your installation location.

Once you have recruited the SSP they will do a site assessment and preliminary design, so basic location and system components are known before you negotiate the SPPA contract.

> *"Pricing is the first litmus test. If the (kWh) price isn't right, there is no deal."*
>
> Morten Lund, Partner, Foley & Lardner LLP

Step 5: Negotiate contract

Before you begin contract negotiations, you will have established that your utility supports solar, located a large unshaded installation location, reviewed your energy costs and efficiency options, and recruited a solar services provider to coordinate your project.

We suggest you use professionals to represent your organization's interest. But be sure they have experience with this type of contract. It is important that they understand both the utility costs and your interests. Appendix 2 is a detailed technical guide to walk you through the contract negotiation process. The appendix describes these key features to understand about contracts before moving forward:

- Electricity pricing
- Financial incentives
- SREC sales and terms
- Site lease agreement
- End of contract term, and pre-term options

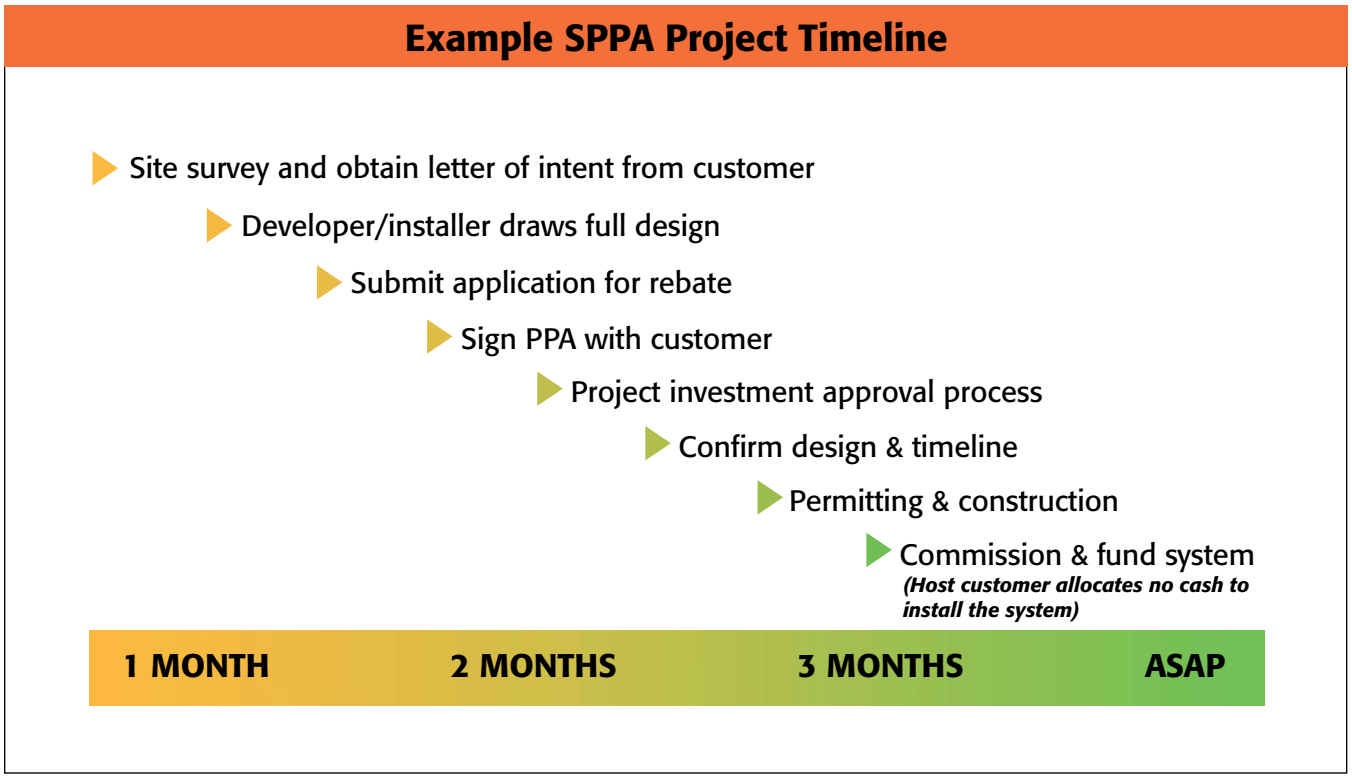

FIGURE 8
Adapted courtesy of MMA Renewable Ventures

Step 6: Collaborate on system design, permitting, and installation

The contract negotiation process may take several months, depending on the number of approvals required for your project and whether your solar services provider already controls project financing or is recruiting funding. The solar services provider has to secure the various incentives available before the investor will commit, and the incentives are not always certain until the project financing is secured. In addition, the project requires approval of permits. To save time and money from the outset, include project timelines and milestones, both for your organization and the SSP (Figure 8).

While the contracting process is detailed, many organizations like yours have completed it. In Chapter 6 we have provided contact information for people who were involved in successful SPPA projects.

The solar services provider will lead the design and installation process, working closely with your staff, solar installation crews, and your electric utility.

Within your organization, clear communications about the solar project will save both time and money. Your project team leader should try to keep your staff and senior decision makers in the loop about the solar project and work with the solar services provider to facilitate project permits and approvals. It is important that you and the provider understand the local permitting process as it relates to solar electricity systems. Each project requires a unique set of approvals from different agencies.

Step 7: Enjoy your solar power

Once the system is installed it goes through a commissioning process in which the utility checks the interconnection, local inspectors ensure the wiring meets electrical codes,

and the installer makes sure the system is producing power as expected. The length of the commissioning process depends on the size and nature of your system and the level of support from your electric utility.

After the system is commissioned, the solar services provider will show you how to read a web-based monitoring service that describes the amount of solar electricity your building uses. The kWh billing information is collected remotely from a revenue-grade production meter. Additional monitoring equipment will inform you that everything is working correctly.

The SSP or their maintenance service contractor will repair and replace equipment as needed to ensure you actually receive the amount of solar electricity described in your SPPA contract. Your staff will notify the maintenance company of any physical changes to the project site that may create shade or otherwise hinder the system's electricity production.

Summary

Implementing an SPPA project can be straightforward, and hundreds of large businesses and municipal organizations have used this strategy with excellent results. Clear communications and planning are the secret to success for achieving your solar power objectives with an SPPA.

Chapter 5
Other ways to buy solar electricity

Now that you understand the SPPA model, in this chapter we describe other ways you can secure solar electricity. The options include buying system equipment directly, buying the system over time with lease-to-own financing, or if available, buying solar electricity from your utility (Figure 9).

System ownership

In Chapter 3 we reviewed interconnection, net metering, and time-of-use metering as they apply to an SPPA project. The same grid connection and metering issues apply to system ownership. The local utility must support connection of your PV equipment in order to install a grid-tied system. In most cases you also need a net-metering agreement, which will provide retail credit for the kWh sent to the grid, making the project cost effective.

The oldest approach for using solar electricity is to install solar panels at your facility and own them outright. You might finance the project with cash, a bond, a loan, or a grant, or you may lease-to-own and pay for the system over time (Figure 10).

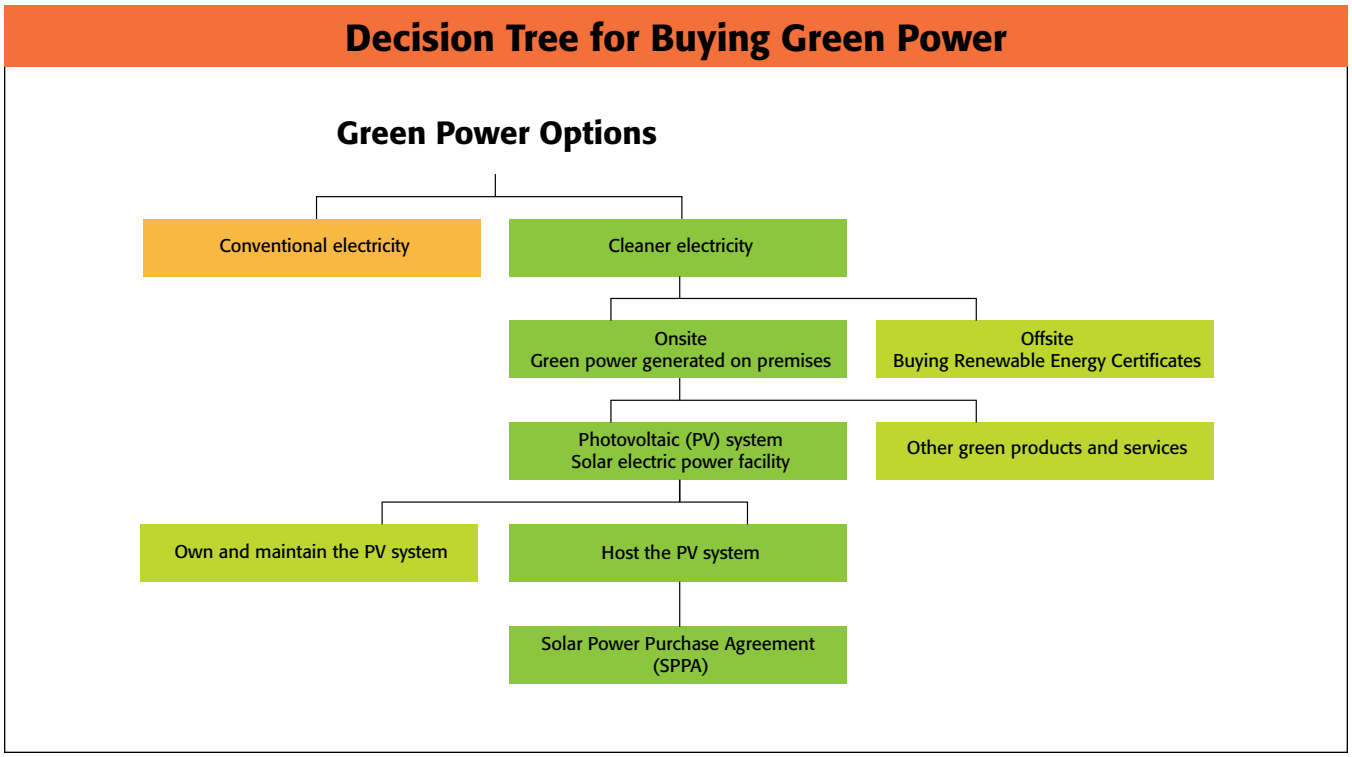

FIGURE 9
Adapted from "Solar Power Services: How PPAs Are Changing the PV Value Chain," GreenTechMedia.

Ownership Financing Comparison Chart

	Cash	Debt/Loan	Operating lease
Initial payment	Highest	Low, regular	Medium, regular
Tax consequences (for system owner with tax liability)	None	Write off interest payment, apply ownership depreciation	Write off entire payment, no depreciation
Use of incentives to lower system cost	100% to you	100% to you	100% to system lessor (not you)
Cost of electricity from solar electricity system	Depends on system cost and opportunity cost of cash used, and overall system kWh production. Only *really* known at the end of system life.	Same	Same
Monthly payments	None	Known with a fixed rate loan	• Negotiated in lease - static monthly payment • Known pre-payment option or penalties
Balloon payments	None	Negotiable	Negotiable
Final purchase payment	None	• Possible ability to pre-pay • Final debt payment per schedule	• Usually no ability to pre-pay • Option to buy or return the system • Price defined as "fair market value" by Internal Revenue Service. No such thing as "buy it for a dollar."
Capital appreciation	• 100% value goes to owner • Value is captured on building sale	• 100% value goes to owner • Value is captured on building sale	None until system is purchased at end of lease. Likely negated by higher overall financing cost.
System maintenance and inverter replacement	100% system owner (may contract out)	100% system owner (may contract out)	System owner will contract out and include cost in monthly lease payment.
Clean power attributes (SRECs)	100% system owner	100% system owner	Negotiable but usually owned by the system owner. The customer does not own the "green" value of the kWh until the system is purchased.

FIGURE 10

The purchase option is fairly straightforward, but differs slightly from an SPPA project. Below, steps 1 to 3 are the same in an SPPA or system ownership scenario. Steps 4 to 7 apply specifically to system ownership.

1) *Research current and projected kWh costs.*
2) *Assess energy efficiency measures and costs.*
3) *Identify possible installation location(s).*
4) *Confirm budget/financing.* We estimate that a large solar power system (100kW and larger) will cost $4 to $7 per watt after applying the 30 percent federal tax credit and accelerated depreciation benefits. The final cost may be even lower after state and local incentives are applied. Supply of equipment and availability of qualified installers will also affect the bottom line.
5) *Recruit bids from solar installers.* We recommend that you seek proposals from several solar installers. Check references, confirm contractors' licenses and financial stability, and verify installers' training and experience. The North American Board of Certified Energy Practitioners certifies both solar PV and solar water heating installers. It is helpful to ask the bidding vendor to include an estimate of the amount of solar electricity the system should produce over a 25-year period. Then you can estimate cost per kWh.
6) *Install.* Establish the scope of the installer's obligation. If you contract for a "turnkey" installation, the installer will design and install the system, obtain all needed permits, and in some cases accept the incentive payments on the customer's behalf.
7) *Maintain the system, and monitor production.* Your solar project should always include a performance reporting system, ideally one that allows you to monitor production on a website. The cost of the monitoring, metering, and reporting system should be incorporated into the overall system price. Confirming that the system is working properly should be a simple process. You will need to maintain the system with occasional module cleaning, and replacement of the inverter 10 to 15 years after installation.

Advantages of ownership:

- Increased building value with the addition of a solar electric system
- The ability to use the system to meet environmental policy goals
- A hedge against escalating future energy costs
- Known system costs and free fuel from the sun
- Less contracting complexity

Responsibilities of ownership:

- Maintaining the system
- Monitoring the system performance and ensure it is working properly
- Replacing system components and working with warranties
- Hiring a broker to sell your SRECs if you want the additional income and don't need the environmental claims

Comparing system prices

It helps to understand the terms used to describe solar electric pricing. Typically, the costs are depicted in "dollars per watt," based on the maximum peak production of the system. You, the customer, are most interested in the cost per kWh because that is what you are displacing from your utility bill.

The amount of kWh production from the same equipment varies greatly depending on the amount of sun hitting your system, the equipment used, and how the system is installed. Following is an example project that shows how to calculate your cost per kWh. In this example the system will be producing 80 percent of its lab-rated capacity at 25 years, as per most module warranties. Realize too, that the system should continue producing electricity for longer than 30 years.

Simplified example kWh cost analysis [1]

Step 1) 100 kW of DC modules – 10 percent inverter inefficiency and line losses = 90kW of AC power

Step 2) Expected production over 25 years for 90kW AC system = 3,359,341 kWh

Step 3) System cost (after 30 percent federal incentive) = $450,000

Step 4) Equipment replacement and maintenance expense over 25 years = $50,000

Step 5) Total cost $500,000
Equals total price per kWh = $.15

Whether or not you choose to buy the equipment or buy just the solar electricity, we recommend you compare the overall cost of the financing method. To compare "apples to apples" apply all costs to the expected kWh produced by the PV system over 25 years. The costs should include equipment maintenance and inverter replacement. The PVWatts online calculator helps to do a basic assessment that includes the amount of sun hitting your location (See Resources).

Financial incentives

A wide range of incentives is available to encourage development of solar electricity. These include equipment rebates, production-based incentives, and tax credits. All of these incentives rely on government policies that support clean solar electricity.

In a solar equipment lease-to-own agreement, the host customer pays only a small portion or none of the system cost at the outset, and then makes fixed payments over time to the system owner. The bottom line with a lease agreement is that you do not purchase the system in the beginning, but do so over time by making regular payments. Unlike an SPPA, under which you only buy the power the system produces, in a lease financing agreement the payments are fixed and don't fluctuate with the amount of energy produced and used.

[1] Used 140kWh/month per kW AC production, which varies greatly by state. Used 1 percent for annual system production degradation.

Local and state government entities may have access to special financing programs and resources for solar electricity systems that make ownership even easier. We recommend reading "Solar Photovoltaic Financing: Deployment on Public Property by State and Local Governments," a recent report by the National Renewable Energy Laboratory that provides a detailed analysis and resources for financing an SPPA. (See References for web link.)

However, note that only with an SPPA do you know exactly how much you will pay for your solar electricity. With an SPPA you buy only the electricity the system produces. The solar system owners are subject to production fluctuations over time depending on the weather, maintenance, and installation quality. Solar PPA customers aren't subjected to these ownership risks.

Both time-of-use and net-metering benefits described in Chapter 3 apply to system ownership as well as SPPAs. If your utility offers both these benefits and you can control your energy use during peak periods, purchasing your own solar equipment may be a good investment.

Incentives, solar policies, and other solar support programs can be found at the Database for Solar Incentives and Renewable Energy website, DSIREUSA.ORG.

Green-pricing programs allow utility customers to pay a small premium on their energy bill in order to buy a portion of their electricity from green sources. Available from more than 800 utilities, green pricing programs offer the simplest way to add renewable energy to your energy mix. The premium you pay to the utility goes toward its purchase or installation of solar, or other green energy supply. Given the nature of the electricity grid, the utility cannot guarantee that the electrons entering your building are from a renewable energy generator. But you are assured that your premium payment added more green electricity to the electric grid. If your goals are strictly environmental, this may be the right option for you.

Federal investment tax credit

The U.S. government has supported the use of solar power for several years with a federal tax credit. The federal solar investment tax credit (ITC) is crucial to the SPPA market. Investors are willing to commit to an SPPA largely because it offers them tax advantages through this credit.

Available for commercial solar projects installed by December 31, 2008, the ITC offers a 30 percent tax credit on the full cost of a system for businesses that own solar. Project owners also take advantage of an accelerated five and a half-year equipment depreciation schedule. Together, these incentives can recover approximately 50 percent of the cost of a PV system. The ITC has spurred the installation of thousands of commercial solar electricity systems.

Federal investment tax credit (ITC)

A federal ITC is vital to the robust growth of the solar industry in the United States, and allows for cost-effective SPPAs. If it is not extended, the ITC will end December 31, 2008 and the commercial credit will revert to 10 percent of the system cost. At press time, Congress had not voted to extend the ITC for solar.

Check SEIA.ORG for the latest update on this key policy.

Summary

An SPPA may be a better option for you if your organization:

- has limited financing options
- uses a lot of electricity
- prefers to pay for solar electricity through the normal operating budget instead of all at once through a capital investment

Solar electricity is an excellent choice for your organization whether you own it directly or buy just the electricity. Using an SPPA to buy the power guarantees the price for the solar electricity, requires no capital investment to buy equipment, and transfers the system maintenance and other risk factors to the equipment owners. Likewise, if you can secure system financing through cash, debt, a bond, or through lease financing, system ownership has its own benefits. Your SPPA agreement may even include the option to buy the solar power for the first few years, and purchase the system equipment later.

In Chapter 6 we review several real-world SPPA examples.

Chapter 6
Real world examples

The following project examples come from well-established solar power services companies. These companies have diverse portfolios, representing many business sectors and customer types.

Denver International Airport (MMA Renewable Ventures, 2008)

System size (AC)	Equipment brands	Term	Host customer sector	Location
2,000kW	Sharp modules Xantrex inverters	20 years with buyout option at fair market value after Year 6	Airport	Denver, Colorado

Project contact: Woods Allee / Phone: (303) 342-2632 / Email: Woods.Allee@flydenver.com

The two-megawatt solar photovoltaic system installed at Denver International Airport (DIA), uses more than 9,200 Sharp solar panels, and features a tracking system that follows the sun during the day for greater efficiency and energy production. The system will generate over 3 million kilowatt hours (kWh) of clean electricity annually, which is the equivalent of half the energy needed to operate the train system at the airport.

This project was developed through an innovative public-private partnership with the City of Denver, DIA, MMA Renewable Ventures, and WorldWater and Solar Technologies, to secure clean solar power generation.

The solar power system is part of the Xcel Energy Solar Rewards program and demonstrates Denver's commitment to environmental sustainability by reducing carbon emissions into the atmosphere by more than 5 million pounds each year.

Photo courtesy of MMA Renewable Ventures

> *"The solar power purchase agreement can be cost-effective from Day One — and deliver growing savings for years to come."*
>
> Matt Cheney, CEO, MMA Renewable Ventures

California State University, Fresno (MMA Renewable Ventures, 2007)

System size (AC)	Equipment brands	Term	Host customer sector	Location
1,173kW	Schott modules SatCon inverters	20 years with buyout option at fair market value after Year 6	State university	Fresno, California

Photo courtesy of MMA Renewable Ventures

Project contact: Dick Smith, Facilities Manager / Phone: (559) 278-2373 / Email: dicks@csufresno.edu

Fresno State is a leader in advancing sustainability initiatives and in the conservation of scarce natural resources. This project is just one of the university's "green campus" initiatives, which serve as a model in higher education. The solar power system generates energy to cover 20 percent of the university's core campus usage. To build awareness and interest in solar generation among students and faculty members, the panels are installed atop carports, and four public kiosks provide the real-time status of the photovoltaic system's performance.

Lagunitas School District - San Geronimo School (Solar Power Partners, 2008)

System size (AC)	Equipment brands	Term	Host customer sector	Location
49.3kW	Evergreen modules Solectria inverters	15 years with buyout option at fair market value at term	School district	San Geronimo, California

Project contact: Amy Prescott, Business Manager / Phone: (415) 488-9563, ext 226 / Email: aprescott@marin.k12.ca.us

This school had reserved a rebate with the state's solar incentive program, but found they lacked capital to purchase the system. Thirty days before the rebate was to expire, Solar Power Partners received a desperate call from a green-oriented architect working with the school. SPP collaborated with a local solar installer on a project design and developed a corresponding PPA. The estimated savings of 20 percent starting in Year 1 was very attractive to the school board. The savings were possible because the school is closed in summer when the PV is producing the most energy and earning credits at the highest tariff rate. The project is complete and is being integrated into the school's curriculum as well as providing the backdrop for the community's "Green Note Festival."

Photo courtesy of Solar Power Partners

"Energy users with a solar friendly time-of-use profile, like many schools and universities, can often obtain the greatest energy cost savings from a Solar Power Purchase Agreement. Further, schools and universities often have unique needs and similar negotiating points. As a result of working with numerous schools and universities, Solar Power Partners has tailored a PPA to match these needs and limit negotiation expenses."

Alexander v. Welczeck, CEO, Solar Power Partners

Fresno Airport (Solar Power Partners, 2008)

System size (AC)	Equipment brands	Term	Host customer sector	Location
Two 1,200kW systems	Sharp modules Xantrex inverters	20 years with buyout option at fair market value at term	City airport	Fresno, California

Photo courtesy of Solar Power Partners

Project contact: Russell Widmar, Director of Aviation / Phone: (559) 621-7500 / Email: russ.widmar@fresno.gov

The City of Fresno, owner of the Fresno Yosemite International Airport (FYI), set a goal and course of action through their Fresno Green program to become a national leader in renewable energy use. FYI was identified as an ideal location to implement a large-scale solar electric facility. In the summer of 2007, Solar Power Partners was approached by World Water and Solar Technologies Corporation to manage the financing and power purchase contract awarded by the Fresno City Council. SPP deployed two 1.2MW DC field installations using an APS single-axis tracking system to maximize annual energy harvest. The installation represents one of the largest distributed PV installations in the U.S. and is expected to produce a combined 4,145,000 kWh annually, approximately 40 percent of the airport's annual power needs. FYI is expecting to save about $13 million in electricity costs over the 20-year term and offset 62,175 metric tons of carbon dioxide.

City of Pendleton Water Treatment Plant (Honeywell, 2008)

System size (AC)	Equipment brands	Term	Host customer sector	Location
100kW	SolarWorld modules Solectria inverters	20 years with buyout option at fair market value at term	Water district	Pendleton, Oregon

Photo courtesy of Energy Trust of Oregon

Project contact: Larry Lehman, City Manager / Phone: (541) 966-0221 / Email: larry.lehman@ci.pendleton.or.us

Installing a solar electric system was a natural next step for the City of Pendleton after several years of implementing various sustainability measures. The 100 kW system located on the roof of the city's water treatment plant will produce 112,000 kWh per year. City Manager Larry Lehman says that the SPPA's 3 percent yearly escalation rate provides predictability for a portion of the city's electric bills. This predictability, combined with the fact that the project came at no cost to the city, made it an easy decision. The system is attached to the ribs in the treatment plant's metal roof; no roof penetrations were used.

City of San Diego's Alvarado Water Treatment (SunEdison, 2007)

System size (AC)	Equipment brands	Term	Host customer sector	Location
1,130kW	Kyocera modules SatCon inverters	20 years with buyout option at fair market value at term	Water district	San Diego, California

Project contact: Tom Blair, Deputy Director, Energy Conservation & Management, Environmental Services, City of San Diego / Phone: (858) 492-6001

More than 6,000 panels atop the concrete roofs of three water storage reservoirs provide more than 1.6 million kWh each year. The system prevented 1.5 million pounds of CO2 emissions in the first year, the environmental equivalent to removing about 140 cars from U.S. roadways annually, or powering 150 homes each year.

Photo courtesy of SunEdison

Chuckawalla Valley State Prison (SunEdison, 2006)

System size (AC)	Equipment brands	Term	Host customer sector	Location
1,000kW	Kyocera and SolarWorld modules SatCon inverters	20 years with buyout option at fair -market value at term	California Department of General Services	Blythe, California

Photo courtesy of SunEdison

Project contact: Harry Franey, California Department of Corrections and Rehabilitation /
Email: harry.franey@cdcr.ca.gov

The California Power Authority began deploying solar with SunEdison in 2006, and now hosts 4 MW of clean, renewable solar power at eight locations to meet rising energy costs and a state mandate to implement renewable energy. One host is Chuckawalla Valley State Prison, a 1 MW ground mounted system installed in June 2006. The prison achieves three goals in hosting a solar system: it saves money on their energy bills, supports their state renewable energy mandates, and incurs no upfront capital expenses.

"Put your money into your core business. Let us be the energy experts."

Jigar Shah, Chief Visionary Officer, SunEdison

Chapter 7
Summary

Renewable power is becoming an important part of our nation's energy supply. More and more businesses and organizations seek electricity from green sources, particularly from solar power, a tried-and-true technology that offers free fuel forever.

As the solar industry matures, new and innovative approaches emerge to help organizations buy and finance solar energy. You can install a system at your site and then own it outright, or finance it with a lease. Or you can use the SPPA approach and allow a third party to own, operate, and maintain the system at your site. You then purchase the electricity from the entity. Each method has its own challenges, but only with the SPPA do you buy just the solar power you use, and at a known rate for 15 to 20 years.

No matter what model you use, you want to understand fully your state and local policy framework, your utility's policies, and how your available financial incentives work. It is also crucial that you seek experienced professionals to help guide you through the project. And finally, no matter what the source of your new clean energy, take time to determine how you can improve efficiency and conservation. The kilowatt saved is the cheapest kilowatt available.

We hope this guide helped you understand solar electricity projects and how to assess your options as you move forward. Please review the Appendices and the Resources section for further details. Thank you for going solar!

Whether you sign an SPPA, or decide to own your equipment, solar electricity provides many benefits for your organization, and for our environment.

Appendix 1
Solar technology basics

- **How it works and the main system components**
- **Technology options and considerations**
- **Factors affecting production**

How it works

Solar technology has more than 60 years of significant testing and use in the field. Solar electricity system components include modules, inverters, and "balance of system" parts (e.g., production meter, wiring, racking, switches). The systems are relatively simple and quick to install compared to other renewable energy technologies, and they have few if any moving parts to maintain.

When sunlight hits PV modules, high voltage direct current (DC) electricity is generated. The DC flows into the system inverter which converts it to alternating current (AC) and steps down the voltage for use in the associated power panel. The amount of power being generated depends on the size and number of modules, their efficiency, their orientation to the sun, and the amount of sunlight falling on the module array (Figure 11).

PV System on Building

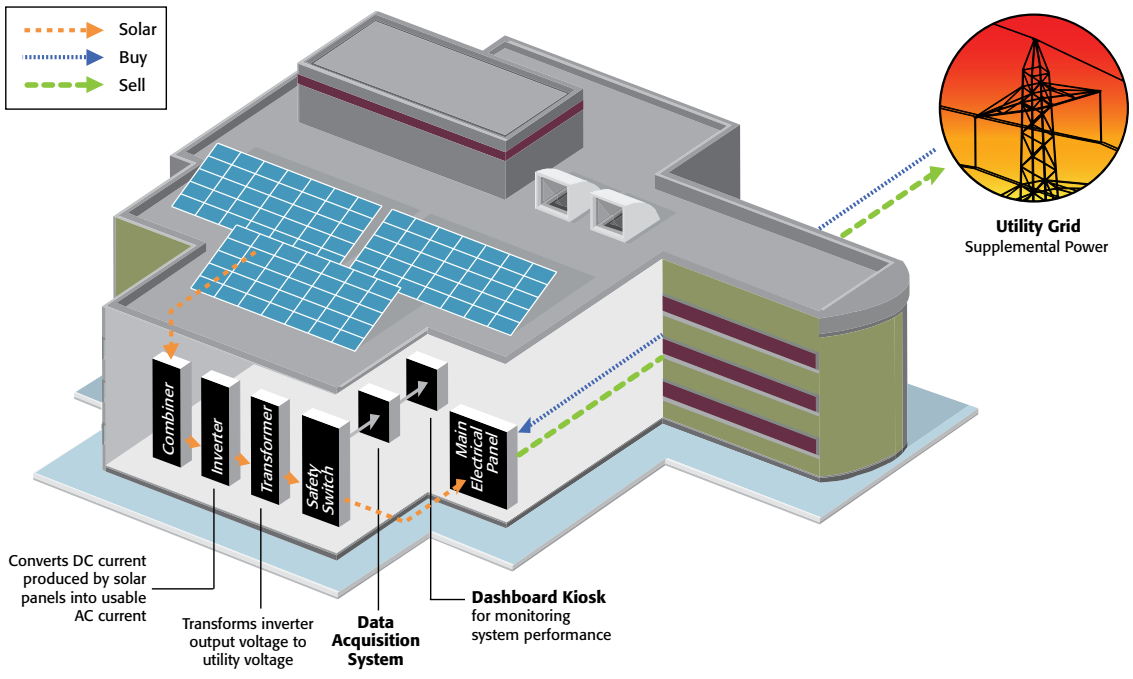

FIGURE 11
Adapted from EI Solutions "Grid-Tied Solar Power System Overview," GreenTechMedia.com

SYSTEM COMPONENTS

Modules

Types. Most solar modules in production today are made of silicon crystal cells. The three main types of silicon-based modules are single-crystal, multi-crystal, and amorphous, a type of "thin film" module. There are also non-silicon-based thin film modules. Single and multi-crystalline modules are more efficient, sturdier, and heavier than thin film modules. Thin film modules are lighter in weight and often applied to flexible materials like a plastic backing. Thin film modules are commonly found in building-integrated applications such as roof shingles, roll-on roof coverings, and windows.

Efficiency ratings. The module efficiency rating refers to the percent of sunlight that is converted to electricity. Single and multi-crystal modules are more efficient than thin film, while thin film is lighter and more flexible. The less efficient a module, the more modules and space needed to produce the target amount of power. In order to compare apples to apples when reviewing project proposals, efficiency is best thought of in terms of cost per kWh produced.

Capacity. The capacity is the maximum amount of energy the system can produce based on how many watts of PV are installed. The bottom line when comparing solar electricity equipment options is the cost per watt, or ideally, cost per kWh over the lifetime of the PV system. Solar customers are ultimately purchasing kilowatt hours (kWhs).

Warranty. Most modules come with a 25-year manufacturer's warranty, meaning that after 25 years the modules should still be producing at least 80 percent of their rated capacity. As there are no moving parts, and the modules are built for long-term stability in all weather conditions, it is likely a PV system will continue producing at least 50 percent of its rated capacity beyond 30, possibly even 40 years.

Maintenance. PV modules require very little maintenance. In dry, or very dusty environments, the system owner should hose off the modules to ensure maximum production throughout the year. The system installer should provide maintenance guidance for local weatherconditions.

Maximum production. Solar modules produce at peak efficiency in cool (but not cold) temperatures, with maximum sunlight exposure. Direct shading on even a small portion of the modules will greatly reduce the amount of power produced. Production will also vary significantly according to local climate conditions and the amount of sunlight hitting the solar modules.

Inverters

Purpose. Grid-tied inverters condition the DC power produced by PV modules into "utility grade" AC power that flows through the electrical panel for use in the building, or back into the utility meter.

Efficiency. The inverter contains the "brains" of the PV system, that monitor and control for peak performance and alert the system operator to any anomalies. Typical inverter efficiency is 88 to 92 percent, meaning that of 100 DC watts coming into the inverter from the modules, only 88 to 92 watts will be converted into usable AC power.

Safety. If the utility grid goes offline (e.g., in a blackout), the inverter also goes offline and any electricity being produced by the PV modules is "dumped" through the grounding wires. This feature protects line workers or others when the lines are down.

Warranty. The inverter warranty is usually 10 years, with expected performance approximately 15 years. Therefore, the system owner should budget to replace the inverters at least once over the useful life of the PV system. The inverter should continue producing at least 50 percent of its rated capacity for more than 30 years.

Features. Each inverter option has costs and benefits that must be analyzed in the context of the entire project. The size of the inverter will depend on the number of PV modules and whether more modules are to be added later. Other considerations are the kWh monitoring and reporting features, such as whether the inverter can send production data through a wireless Internet connection.

The inverter must usually be replaced usually 10 to 15 years into the project. This cost must be configured into the project budget.

Location. Inverters work most efficiently in cool, clean conditions.

kWh production factors

Installation location and production. The U.S. generally has an excellent solar resource. Other countries, such as Germany, have a considerably weaker solar resource, but nonetheless produce much more solar energy than we do because of very generous solar policies and financial incentives.

These guidelines, for those in the northern hemisphere, are useful in estimating what size PV system you will need to install:

- **Weight:** A common roof-mounted system with racking weighs 3 to 5 pounds per square foot.
- **Space:** 1,000 to 1,500 square feet per 10,000 watts of modules. Plan on 10,000 square feet for a 100kW roof-mounted system.
- **Production:** 900 to 1600kWh per month per 10,000 watts of modules. Production will be higher in summer, lower in winter, and vary greatly by location. (See PVWatts in Resources for estimate.) The PV modules should face southward and be tilted for maximum annual kWh production. Production is also boosted by adding tracking equipment that tilt the modules toward the sun.

Installation structure. PV modules may be installed on building roofs (flat or tilted), shade structures (e.g., parking lots, parks, pools, transit terminals), or mounted on standing poles, along hillsides, or in open fields. Any unshaded solid structure that will last 10 or more years provides a good solar installation location. It is common to install the system in conjunction with a re-roofing project, or when creating a dual-benefit structure, such as a new parking lot shading system with integrated PV. The system may be mounted on a flat roof, using no-penetration ballast anchors, or on poles with dual tracking to maximize production.

FindSolar.org and ASES.org are excellent online resources for installing a solar electric system.

Appendix 2
SPPA contracts technical guide

The contracting process doesn't have to be complicated, but it's made easier and faster with some pre-research and an understanding of the process. This section attempts to raise questions and concepts that will help you navigate the SPPA contracting process.

Creating variations on the SPP's standard offer product costs time and money to negotiate, so if you minimize special requests and unusual options, you can achieve a more attractive electricity price.

Electricity prices are expected to rise, and in some cases dramatically. Here is the forecast directly from the Energy Information Administration:

> **Prices.** *Many utilities are continuing to pursue retail electricity rate increases in response to power generation fuel costs that have risen dramatically over the last 2 years. For example, the delivered cost of natural gas to the electric power sector in March 2008 was.... 25 percent higher than the average cost in March 2007. Average U.S. residential electricity prices are expected to increase by 5 percent in 2008 and by 10 percent in 2009* (Short-term Energy Outlook, Energy Information Administration, September 9, 2008). http://www.eia.doe.gov/emeu/steo/pub/contents.html

Key contract features

These are the core sections of your SPPA contract, but they may be combined into one or more documents:

- Solar electricity pricing and assured performance
- SREC sales and terms
- Site lease
- Pre-term and end-of-term options

To assess the economics of your project over 10 to 20 years, consider:

- Capital costs
- Energy production
- Tax credits and incentives
- Effect of SRECs
- Projected discount rate
- Operating costs, maintenance, insurance, etc.
- Current price of energy
- Projected energy price increases

Solar electricity pricing

This section of the SPPA contract describes how much you will pay for kWh from the PV system, and how this amount is adjusted over time. To assess the economics of your project over 10 to 20 years, consider your price for PV kWh in terms of:

- Capital costs
- System energy production
- Tax credits and incentives available to owner
- Effect of SRECs
- Projects discount rate
- Operating costs, maintenance, insurance, etc.
- Current price of energy
- Projected energy price increases

> **Fixed with escalator.** In this price structure, the price per kWh is fixed and includes a fixed annual escalation rate (%). The escalation rate accounts for system production decreases over time, and inflation-related cost increases for system operation and maintenance.

Whether the starting price is higher or lower than the customer's current utility rate depends on how the pricing

is structured. The price negotiation includes where to start the kWh rate, using a fixed or step-based escalator rate, or some combination of kWh rate and inflation schedule that accounts for the time-value of money, and provides a return on investment for the system owners.

Ultimately, the cost of kWh depends on the size and complexity of the project, the incentives available to the system owner, the various options afforded to the customer, and the host's credit rating.

The SREC contract, which may be separate from the SPPA or incorporated within, impacts the kWh rates as well.

Projects may start with a kWh rate price higher than their current tariff, but with a flat escalator and known rates for the long term. Typical escalation rates are currently 3 to 5.5 percent.

Fixed non-escalating. With this price structure, the host customer may begin buying the PV kWh at a rate higher than their current utility rate, but the rate does not change over time. This structure makes great sense when the host customer has great confidence their utility rates will be increasing significantly.

Variable with utility. The kWh price is equal to or less than the utility price, possibly with minimums and maximums defined. This is a fairly rare SPPA price structure and is sometimes referred to as "Business as Usual."

Your electricity bill

In preparation for the contract negotiation phase of the SPPA project you will have already consulted your electric utility about available tariffs and their forecasted electricity prices.

Your electricity bill may have several distinct types of charges. Here we list the most common rate factors that change with the amount of kWh being purchased:

1. **Demand Charges:** monthly payment based on your peak demand average from past use. Consult your utility and your project consultant to understand whether the PV project will have a significant effect, either positive or negative, on the demand-related charges on your regular utility bill.
2. **Daily Demand Charges :** daily charge based on peak demand
3. **Tariff:** this is the rate you pay for kWh and it changes during the seasons. It may also change during the time of day if you are on a time-of-use tariff. Ask your utility if there is a tariff that could lower your rate for conventional kWh once you are also using PV power. For instance, some school districts export PV kWh during the summer and receive credit toward their winter energy bills.

Once you understand the 'all inclusive' kWh price you are currently paying your utility, known as the "reference tariff," you can then compare this against the proposed SPPA PV rate. This part of the SPPA contract describes your utility pricing in detail, and the procedure for selecting a new reference tariff for the SPPA in case the original tariff changes or is canceled.

When calculating your electricity costs, and the corresponding PV power benefits, ***do not use an "Average Unit Cost" method.*** The average cost method is used for budgeting purposes and is based on throwing all energy costs together and dividing the bundle by the amount of kWh used. This produces a falsely high kWh rate and fails to show the actual effect of the PV system on your utility bill. For a detailed discussion of the Average Unit Cost visit Energy Management World's discussion papers: http://www.energymanagementworld.org/diligence.html.

Transaction costs

In most projects the host customer is investing their own transaction costs (e.g., staff time, consulting services, legal fees, travel, etc.) into the project and these costs should be reflected in their overall economic project analysis. In some cases the host customer might bill the SSP for their transaction costs but the funding essentially comes out of the hosts' electric bill from the SSP. Host customers requesting this added transaction may be paying for the service through the power purchase agreement in the form of higher kWh prices.

Assured performance

The kWh price and total project economics are based on how much usable electricity the PV system will produce over the long term. If the PV system does not produce as much as expected, the customer is purchasing more utility power than they planned and potentially losing expected savings. Customers with large enough projects may seek minimum performance guarantees, and may want to specify compensation should the system fail to produce as expected. Some SSPs don't include performance provisions in their standard contracts because it is in the system owner's interest to ensure maximum system production, and therefore maximum kWh income from the host customer.

This section of the contract will also identify the "**annual degradation factor,**" which is the percent of estimated production decrease from year to year to account for system degradation over time. For reference, module warranties often describe that the module should produce at least 80 percent of their original power rating after 25 years in the field, which reflects an annual degradation factor of .08 percent.

Solar renewable energy certificates

SRECs are described in Chapter 3 of this Guide but, as it's a fairly complicated concept, we reiterate the information and go into more detail here to provide guidance relating to the SREC portion of your contract.

The SREC represents the renewable energy "attributes" from a single megawatt hour (MWh) of solar electricity. These trading products are used to promote the use of renewable energy by splitting the green value of the kWh off from the basic power unit. As SRECs are priced in MWh, and your contract is based in kWh, remember to multiply the kWh figure by one thousand when comparing SREC market prices against the price offered by your solar services provider.

In a mandatory REC market, where SRECs are used as a financial incentive to support the use of solar PV, the system owner will use the incentive to help pay for the system equipment. In a voluntary market, the standard offer from your SSP will vary, from always offering the SRECs for sale to the host customer, to offering a certain percentage of them, to not offering them at all.

Because the SREC market and global warming policies are changing rapidly, the best option for the host customer (in a voluntary REC market) is the option to purchase the SRECs, either at the beginning or some point in the future. In this way the customer has the option to meet policy and marketing goals with their SRECs as the value of these certificates becomes more clear to the marketplace. In all cases your SSP should be familiar with the REC marketplace and will provide guidance on meeting your objectives.

For a full discussion of SRECs and the REC marketplace refer to the Center for Resource Solutions and Green-E websites (References).

Site lease

This section describes the details for facility access and maintenance required by the SSP or its subcontractors to ensure optimal system performance. It details the provisions in case of emergency, meter testing, and notification provisions in case the system has to be turned off by on-site staff. While it is important to clarify these details, the vast majority of PV maintenance and monitoring will take place via remote system controls.

The site lease also clarifies what happens if the building changes ownership or is leased by a new party before the end of term. Ideally the new owner or building tenant will be qualified to take on the SPPA directly, but if not the system can be moved to the host's new location, at the host's expense. In the event of property ownership or use changes the customer is still committed to buying the PV kWh for the term of the contract (15 to 20 years). Moving or selling the building or property on which the PV system is installed does not release the customer from purchasing the kWh.

Property taxes

The PV equipment adds value to your property. Even though someone else owns the equipment in an SPPA, your property may be reassessed at a higher value after

the system is installed. It is important to the economics of the project that the PV system does not cause additional property taxes due to the addition of the solar equipment. If additional taxes will be paid be sure to include this cost when evaluating the costs of the project.

Insurance

Check with your insurance company regarding the additional riders and required coverage for the PV system. The SPPA kWh price reflects insurance costs, so if the Host can insure the system at less cost than the SSP the kWh

Under the radar issues

There are "under-the-radar" issues such as insurance, property taxes, sales taxes, and other costs that impact project economics and the feasibility of entering into third-party ownership agreements.

Facility Access. Some plant/facility managers and security staff, may not be comfortable with a third party having access to and installing equipment on their property. Ongoing site access is critical to the performance of the system and if that is not acceptable, the third-party ownership model will unlikely be a viable option.

Transaction Costs. The third-party ownership model requires knowledgeable lawyers to assist with implementing the appropriate contracts so that the various federal tax incentives can be monetized. While the host is not involved with all of the contracts that need to be signed, it is involved with the PPA itself and must be ready to allocate resources to ensure its interests are represented in the final contract.

Municipal-Specific Contractual Issues. Most state and local governments approve the funding of their operating obligations on an annual basis, so there is a question about the enforceability of a long-term PPA. This is typically addressed through two mechanisms:

- *Non-appropriation clause:* A non-appropriation clause permits the hosting customer to terminate the PPA at the end of any appropriation period without further obligation or payment of any penalty, if and only if, the host was unable to obtain appropriation for funds to meet future scheduled payments and a formal resolution or ordinance is passed. Often, this type of clause will contain a "best efforts" requirement, i.e., the customer promises to use its best efforts to seek and obtain the necessary appropriation for payment. This provision is common in tax- exempt leases and is designed to enable the customer to account for the PPA obligation as a current expense instead of debt.

- *Non-substitution clause:* In today's fast-evolving solar industry, non-substitution clauses are used to protect a project's viability. If a PPA is canceled due to non-appropriation, the clause prohibits the customer from replacing the hosted equipment supported by the PPA with equipment that performs the same or similar function. A non-substitution period of 365 days is common, and shorter time periods are also used. Decisions regarding the length of the non-substitution period are based partly on the perceived essential nature of the equipment. Generally, the more essential the equipment is, the shorter the non-substitution period will be. Given the host's right to cancel under the non-appropriation clause, the non-substitution clause is intended to provide some comfort to the investor and the project developer.

Check with your utility to ensure that 3rd party ownership of a PV system does not preclude the project from accessing available incentives.

"Under the radar issues" reprinted with permission from National Renewable Energy Laboratory Technical Report (NREL/TP-670-43115) Solar Photovoltaic Financing: Deployment on Public Property by State and Local Governments, (May, 2008), by Karlynn Cory, Jason Coughlin, and Charles Coggeshall.

rate will reflect these savings. Insurance companies are not yet very familiar with PV equipment and you will want to make sure the system is covered, as well as the building on which it is installed.

Mid-term and end-of-term issues

The mid-term and end of term options will be clearly spelled out in this section. Pre-term options might include the process for when there are changes in the contracted parties (the special purpose entity, investors, system maintenance contractor, building owner, etc.) or purchasing the SRECs.

One of the main pre-term options is whether the host has the option to purchase of the system prior to the end of the SPPA contract. In many cases the host has this option at year six, after the project investors have exhausted the tax benefits and accelerated equipment depreciation associated with owning the system. At this point the host may be able to buy the system at "fair market value," which is determined by a process approved by the IRS. The federal tax credits and other benefits that accrue to the system owners and make the SPPA kWh sales possible are highly structured and require a tax attorney to fully comprehend. We recommend that host customers not go into an SPPA with the primary goal of buying the PV system at a significant discount six years into the project. While this may end up being possible, the SPPA is primarily designed to be a power purchase agreement, with equipment ownership transfer a secondary - and not necessarily simple, option.

At the end of the PPA term the system Host will usually have these options:

- purchase the system equipment at "fair market value" or a pre-defined 'residual' cost, *whichever is higher.*
- Continue (extend) the SPPA and continue arrangement as is
- SSP will remove the equipment for reuse at some other site.

Whenever the solar equipment is sold, it must be sold for fair market value as determined by an IRS approved valuation process. Vendors who suggest that the equipment may be purchased for less than fair market value are misrepresenting the established IRS guidelines.

Summary

Contracting discussions are a reiterative process. Several initiatives will be taking place at the same time and progress on any one step may depend on external players, for instance, the PV incentive program or the city permitting authority. Some SSPs will come to the table with pre-approved funding, others will gather your project details together and recruit a funder as the project details are finalized. The Investor will not provide the funding until all incentives and contract details are known, and incentives may not be confirmed until the project financing is in place. As with all large capital projects, clear communication and planning can make all the difference.

There are several examples of the RFP and pieces of SPPA contracts, and even more examples of documents from Energy Service Performance Contracts. See the APPENDIX for links to these documents.

Resources

American Council on Energy, Efficiency, and the Environment (ACEEE.ORG)
American Solar Energy Society (ASES.ORG)
Center for Resource Solutions (Resource-solutions.org)
CaliforniaSolarCenter.org
Clean Energy States Alliance (Cleanenergystates.org)
Database of State Incentives for Renewable Energy (DSIREUSA.ORG)
EPA Green Power Partnership (Epa.gov/grnpower)
EvolutionMarkets.com
FindSolar.com
Florida Solar Energy Center (Fsec.ucf.edu)
Foley & Lardner, LLP. Contact: Morten Lund Email:mlund@foley.com (FOLEY.COM)
Green-E (GREEN-E.ORG)
GreenTechMedia.com
HMH Resources, Inc. Contact: Wallace McOuat (HMHRESOURCES.COM)
Interstate Renewable Energy Council (IRECUSA.ORG)
MMA Renewable Energy Ventures (MMARenew.com)
National Renewable Energy Lab (NREL.GOV)
North American Board of Certified Energy Practitioners (NABCEP.ORG)
Prometheus Institute for Sustainable Development (PROMETHEUS.ORG)
PVWatts (Rredc.nrel.gov/solar/codes_algs/PVWATTS)
RenewableEnergyWorld.com
Solar American Initiative (Www1.eere.energy.gov/solar/solar_america)
Solar Electric Industries Association (SEIA.ORG)
Solar Electric Power Association (SolarElectricPower.org)
SolarPowerPartners.com
SunEdison.com
U.S Energy Efficiency and Renewable Energy Department (Eere.energy.gov)
U.S. Energy Information Administration (Eia.doe.gov)

Acronym glossary

AC: Alternating current
ACEEE: American Council for an Energy-Efficient Economy
APS: Alternating power source
CESA: Clean Energy States Alliance
CSI: California Solar Initiative
DC: Direct current
EPA: Environmental Protection Agency
kW: Kilowatt
kWh: Kilowatt-hour
LLC: Limited liability corporation
MW: Megawatt
MWh: Megawatt-hour
NREL: National Renewable Energy Laboratory
PV: Photovoltaic
REC: Renewable energy certificate
RFQ: Request for qualifications
RFP: Request for proposal
RPS: Renewable portfolio standard
SGIP: Self-Generation Incentive Program
SSP: Solar service provider
SPPA: Solar power purchase agreement
SPE: Special purpose entity
SREC: Solar renewable energy certificates
STC: Standard test conditions
TOU: Time of use

Terms Glossary

Alternating current: Alternating current reverses direction at periodic intervals, called cycles.

Building envelope: The walls, roof, doors, foundation, windows and other aspects of a building that protect the indoor environment. The building envelope plays a key role in regulating interior climate and air flow.

Direct current: Electric current that flows in a continuous direction and has a constant polarity.

Energy efficiency: Using less energy/electricity to perform the same function.

Green policy: Government policies that encourage use of renewable fuels.
Greenhouse gases: CO2 and other gases trapping excessive heat in the earth's atmosphere.

Grid-tied: An electrical generator that links to the main utility infrastructure.

Interconnection: The linkage of transmission lines between two utilities, enabling power to be moved in either direction. Interconnections allow the utilities to help contain costs while enhancing system reliability.

Inverter: The equipment that turns DC electricity into AC electricity.

Off-grid: A generator that is not connected to a larger web of power plants and consumers through power lines. An off-grid generator is built near or at the site where the power is used. This also is called on-site generation.

Kilowatt: One thousand (1,000) watts. A unit of measure of the amount of electricity needed to operate given equipment. On a hot summer afternoon a typical home, with central air conditioning and other equipment in use, might have a demand of four kW each hour.

Kilowatt-hour: The most commonly-used unit of measure telling the amount of electricity consumed over time. It means one kilowatt of electricity supplied for one hour.

Megawatt: One-thousand kilowatts (1,000 kW) or one million (1,000,000) watts. One megawatt is enough electrical capacity to power 1,000 average homes.

Meter: A device for measuring levels and volumes of a customer's gas and electricity use.

Module: An individual assembly of cells designed to produce power when exposed to sunlight.

Net metering: Legislative provision that allows an electrical utility customer to receive credit for electricity produced by a qualifying generation system, such as solar or wind. The energy produced by the generation system and sent to the utility is subtracted from the energy consumed. Negative balances are carried forward for a period of time, stipulated by the applicable law. At the end of the designated period, a reconciliation or "true-up" of the account is performed.

Peak usage period: The electric load that corresponds to a maximum level of electric demand in a specified time period.

Photovoltaic: The effect of sunlight (photons) generating electricity without mechanical conversion.

Power purchase agreement: Contract fixing the terms of an electrical energy service agreement between an energy service provider and an end user.

Renewable energy: Resources that constantly renew themselves or that are regarded as practically inexhaustible. These include solar, wind, geothermal, small hydroelectric, and wood. Renewable resources also include some experimental or less-developed sources such as tidal power, sea currents, and ocean thermal gradients.

Renewable energy certificate: A tradable commodity that monetizes the environmental or policy attributes of one megawatt hour of renewable energy. These certificates are traded separately from the physical electricity generated by a renewable energy plant.

Revenue grade production meter: Refers to accuracy, reliability, and method of electricity metering which is required to meet the criteria for billing or settlement purposes, as established by the governing authority with jurisdiction over the transaction. Two common revenue-grade meter standards are plus or minus 5 percent or 2 percent.

Solar installers: Person or organization that physically places and connects solar equipment.

Solar panel: A photovoltaic cell that can convert light directly into electricity. Typical solar cells use semiconductors made from silicon.

SRECs: RECs containing values derived specifically from solar-generated electricity.

List of figures

October, 2008
A Rahus Institute Publication

the
Rahus Institute

Solutions for a
Sustainable World