GUIDE TO COOPERATIVE RESIDENTIAL SOLAR PROGRAMS

PREPARED BY:
RON REBENITSCH

August 2017
Distributed Energy Resources Work Group
Business & Technology Strategies

This Guide to Cooperative Residential Solar Programs ("Guide") is owned by the National Rural Electric Cooperative Association (NRECA).

For more information about the Guide, please contact: Andrew Cotter, **Andrew.Cotter@nreca.coop**.

Disclaimers

The Guide is intended to be a general resource for electric cooperatives. It is not an exhaustive and complete examination of every issue associated with residential solar program design. The Guide is not tailored to specific state laws or specific facts and circumstances that may apply to an electric cooperative. NRECA is not attempting to render specific legal or other professional advice in this Guide. NRECA encourages cooperatives to consult with qualified attorneys, consultants, and accounting and tax advisers. Specifically, members are cautioned to keep in mind federal tax law requirements for cooperative operation as well as antitrust law prohibitions when discussing rates and rate design with others. Case studies are provided in the Guide as examples only to illustrate how various residential solar program designs and related practices have worked at some cooperatives. NRECA is committed to complying fully with all applicable federal and state antitrust laws. NRECA is not endorsing any particular residential solar program design or practice featured in these case studies and is not suggesting they are appropriate for every cooperative. Electric cooperatives are (1) independent entities; (2) governed by independent boards of directors; and (3) affected by different member, financial, legal, political, policy, operational, and other considerations. For these reasons, each electric cooperative should use its independent judgment and discretion to make its own business decisions on whether and how to use the Guide, and in determining whether to develop and implement a residential solar program.

Disclaimer of Warranties & Liability: This guide is provided "as is," and NRECA makes no warranties or representations, either express or implied, about the information contained in the guide, including warranties of accuracy, completeness, or usefulness.

The Guide contains findings that are general in nature. Readers are reminded to perform due diligence in applying these findings to their specific needs, as it is not possible for NRECA or its contributors to have sufficient understanding of any specific situation to ensure applicability of the findings in all cases. The information in the Guide is not intended to develop and does not develop best practices, recommendations, duties of care, standards, or similar items, whether direct, indirect, express, implied, de facto, or otherwise. Similarly, the information in the Guide does not intend to create, expand, or otherwise impact an electric cooperative's legal duties, obligations, expectations, or liabilities. NRECA does not assume liability for how readers may use, interpret, or apply the information, analysis, templates, and guidance herein or with respect to the use of, or damages resulting from the use of, any information, apparatus, method, or process contained herein. In addition, NRECA makes no warranty or representation that the use of these contents does not infringe on privately held rights.

License Right and Confidentiality: This Guide is intended solely for internal use by NRECA electric cooperative members and should be treated as confidential and only shared with others, such as cooperative advisers and consultants, on a "need-to-know" basis.

Table of Contents

FIGURES

TABLES

Preface

Purpose: The goal of this guide is to provide tools and a pathway for a cooperative to evaluate and develop a solar photovoltaic (PV) program for its consumer-members, both residential and commercial and industrial (C&I).

Why Offer this Guide? As renewable energy technology advances and costs decline, renewable energy generation is rapidly becoming attractive for many consumers. This guide provides information to help cooperatives address and work with solar technology as consumer interest in solar generation continues to grow.

What to Expect in this Guide: The guide presents potential issues, options, and concepts for designing and developing a residential solar program, as well as providing a general understanding of residential solar technologies and programs to assist cooperatives in assessing their options. It also reviews several case studies of cooperative and non-cooperative utility solar offerings.

Introduction

With the increasing availability of alternative power supplies, cooperatives may well conclude they need to prepare for a transformational shift in how they serve their member-consumers.

Under the current rate structures prevailing in many areas, simple solar systems (without storage) already offer sound economics; as costs continue to drop, the viability of these systems will spread across a broad spectrum of the consumer base. The declining cost of solar generation has resulted in a tripling of U.S. utility-scale solar PV generation from 2013 to 2015, with smaller-scale installations for residential and commercial following the same trend.[1] (Small-scale solar PV installations are defined by the U.S. Energy Information Administration [EIA] as having a capacity of less than 1 megawatt [MW], usually located at the consumer's site of electricity consumption.)

Given the growing evidence, it appears that solar energy may bring change to the common utility model, in which the utility provides the sole power supply and the wires to deliver that supply. With the increasing availability of alternative power supplies, cooperatives may well conclude they need to prepare for a transformational shift in how they serve their member-consumers—working with them on a solar program may be a prudent path.

As rooftop solar installations become more common, member-consumers are becoming increasingly interested in solar generation, as shown by Figure 1 from the *2015/2016 Touchstone Energy Survey on the Cooperative Difference.*

[1] https://data.bloomberglp.com/bnef/sites/4/2016/02/BCSE-2016-Sustainable-Energy-in-America-Factbook.pdf, Section 4.1.

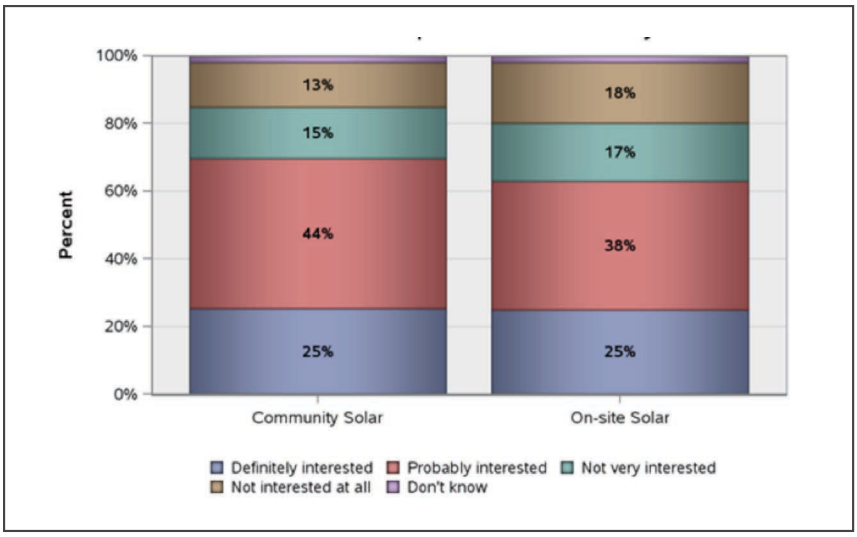


Figure 1: Consumer Interest in Solar Generation. *Source: Touchstone Energy National Survey. More information is available to Touchstone Energy (TSE) members on cooperative.com.*

A key takeaway from this survey is that more than 60% of member-consumers are interested in solar, and 25% of those are "definitely" interested. At the same time, declining costs are introducing new players, such as third-party solar developers. These changes are driven by advances in new technologies and, although they present challenges, they also present new opportunities for cooperatives to enable, facilitate, and engage member-consumers in having more choices for energy supply and delivery.

Cooperatives can offer valuable options for renewable solar, but in the absence of cooperative-provided solutions, member-consumers may find other competitive providers for solar installations. In providing these solutions, and as described in NRECA's report, *The 51st State — A Cooperative Path to a Sustainable Future,* programs and policies should incentivize solar deployments in ways that are reasonable and fair and do not shift costs to other member-consumers.

In meeting this goal, the following will be key considerations for cooperatives:

1. Establish rate structures that equitably compensate solar member-consumers for net excess generation
2. Ensure that solar member-consumers pay their share of system costs
3. Establish standards for solar technologies to interconnect to the system safely and reliably

Early development of a residential solar program can provide a cooperative with the opportunity to interact with its member-consumers while gaining knowledge and experience in solar generation, as well as credibility with policymakers.

This guide is organized to follow the same steps a cooperative would take to develop a residential solar program. After exploring the development process, the guide reviews the solar offerings of several cooperative and non-cooperative utilities.

Development Process:

1. Define Goal and Objectives
2. Assess the Demand (level of member-consumer interest and competitive position) and Business Case
3. Design the Solar Program Offering
4. Develop a Marketing Plan (communicating the program to member-consumers)
5. Develop Resource and Staff Planning
6. Establish Agreements with Member-Consumer Subscribers
7. Execute the Program
8. Solar Program Case Studies
9. Appendix

Executive Summary

This document was created to help cooperatives consider the merits of solar generation and offer a guide to developing a residential solar program. The end goal of such programs is to provide interested member-consumers with an optional PV solar program alternative and the means to acquire it in a manner in keeping with the utility's strategic goals and financial requirements. This guide includes multiple references to community solar because many of the issues involved in individual residential solar installations are similar to those that occur with community solar projects and programs.

When cooperatives decide to develop a residential solar program, they should review the following checklist, which lists the typical steps needed:

1. Define Goal and Objectives
2. Assess the Demand (level of member-consumer interest and competitive position) and Business Case
3. Design the Solar Program Offering, including the following:
   a. Determining the type of program to be offered
   b. Defining the technology to be offered
   c. Determining the details of the financial offering to member-consumers
   d. Determining how the co-op may benefit from a regulatory/policy perspective
4. Develop a Marketing Plan (communicating the program to member-consumers)
5. Develop Resource and Staff Planning
6. Establish Agreements with Member-Consumer Subscribers
7. Execute the Program, including the following:
   a. Engineer, Install, and Interconnect the Systems
      i. Ensure that the program meets codes and obtains permits
      ii. Commission the system
   b. Set Up Billing Systems
   c. Monitor Maintenance and Member Services in the Long Term

Note that each or all of these activities can be done in house or in partnership with a third-party provider.

The power industry is changing — and new disruptive technologies are challenging utilities everywhere.

Key Risks and Challenges to a Residential PV Program

Developing and implementing a residential solar program will be challenging and involve risks that a cooperative's management and board must identify up front and understand well. Many of these risks can be mitigated through collaborative efforts with knowledgeable resources, careful analysis, and comprehensive planning.

The analysis should also recognize the risk of inaction. The power industry is changing — and new disruptive technologies are challenging utilities everywhere. Delaying action may increasingly put a cooperative in a defensive position, resulting in the co-op having to play "catch-up" with shifting consumer trends. The potential impacts of not engaging with these alternative trends should be considered strategically within the context of how the cooperative is positioned to meet the future needs of its member-consumers.

In the early stages of program development, cooperative management should review the risks and challenges listed in Table 1 so they can put mitigation strategies and planning in place as the process proceeds.

Table 1: Risk and Mitigation Summary

Risks	Mitigation Approaches
Risk of inaction	• Comprehensive scan of the competitive environment, trends, and drivers for solar; evaluation of appropriate competitive responses, if needed • Assess impacts as you position the cooperative strategically for the future • Understand the costs and impacts of possible alternatives; explore a simple financing approach • What is the regulatory and policy landscape? Will the cooperative potentially become subject to renewable energy mandates? • Where else will your members turn to meet their renewable energy demands?
Financial risk	• Carefully model and analyze the financial options and drivers that will impact financial results
Retail financing program costs	• Recognize the fully burdened total program cost • Carefully model and analyze the financial options and drivers of retail finance • Review the NRECA's *Retail Financing Guide*
Lack of participation or over-participation	• Clearly describe the overall value proposition • Ensure a comprehensive marketing and communications plan • Model worst-case scenarios • Adjust project scale based on results
System underperformance	• Model the impacts of an underperforming system • Require performance guarantees by third parties • Require performance guarantees by the cooperative
Bad partnership	• Define expectations and requirements clearly • Require well-written, detailed contracts • Select vendors carefully
Technology obsolescence	• Assess refinancing options • Assess community solar program switching
Codes and standards	• Assign risk to the vendor/installer • Work with local authorities having jurisdiction (AHJs) and integrate codes and standards into the program
Cyber security and software interoperability	• Identify data that require confidential management • Acquire cyber security risk insurance • Verify MultiSpeak compliance • Require software documentation
Staffing risks	• Ensure that the assigned project manager and other key staff have the right skills, capabilities, and bandwidth • Conduct cost-benefit analysis of insourcing vs. outsourcing various duties

Solar Industry Overview

The rapid growth of the solar industry can be seen in Figures 2a and 2b.

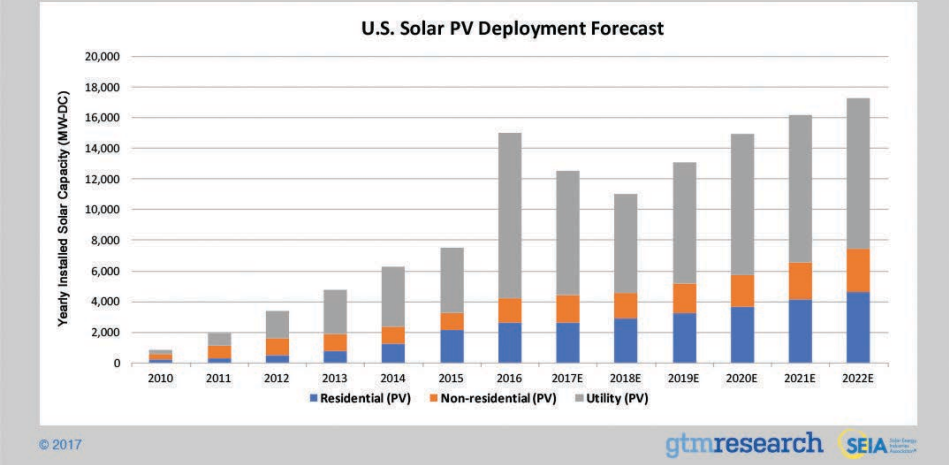


Figure 2a: Solar PV Deployment Forecast, 2010–2022 (Estimated). *Source: GTM Research and the Solar Energy Industries Association (SEIA).*

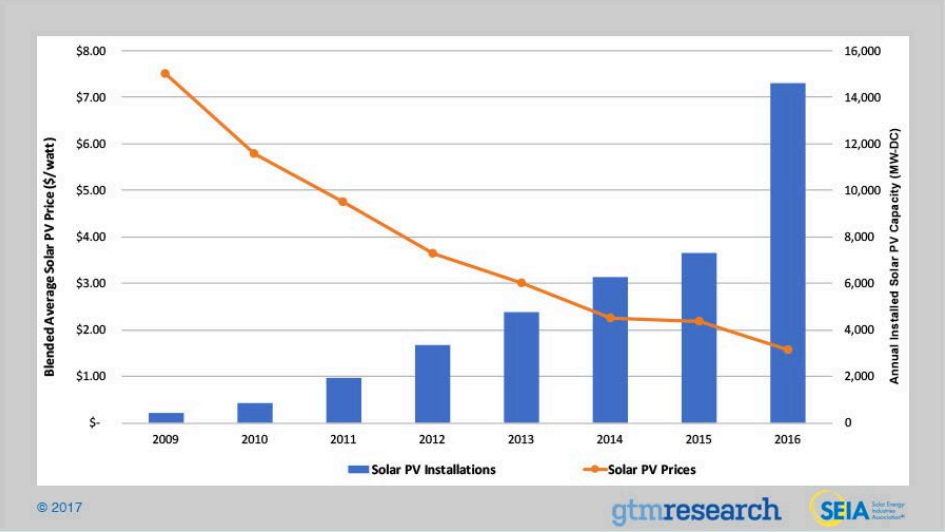


Figure 2b: Solar PV Deployment Forecast, 2010–2016. *Source: GTM Research and SEIA.*

The number of solar installations in the U.S. reached 1 million in 2016, and SEIA projects that the number will double in the next two years, with the bulk of these installations at residential or commercial levels.

This growth is expected to continue; GTM Research estimates that the U.S. installed 14.5 GW of new PV capacity in 2016, representing a rise of 94% year on year. This growth is reflected in the major role of solar in the construction of new generation:

- In 2015, wind and solar projects constituted roughly two-thirds of new generation resources constructed in the U.S.
- The number of solar installations in the U.S. reached 1 million in 2016, and SEIA projects that the number will double in the next two years, with the bulk of these installations at residential or commercial levels.

Another indicator of the dynamics of the solar industry is the rapid growth of solar start-up companies, with many of them achieving million-dollar revenue streams in just a few years. It is important to recognize that some of these companies are achieving their success by targeting price-vulnerable markets that local utilities may have not properly priced in their rate structures.

The main factors driving the high growth of the PV industry are:

- Declining cost of PV installations
- Continuing advances in PV technologies and more integrated packages
- Increasing consumer awareness of and desire for solar PV
- Aggressive and sometimes misleading marketing by third-party providers

The "home of the future" is already a reality, with an internal energy system that combines solar panels, an inverter, battery storage, and an electric vehicle charger, all managed by an app. The development of lower-cost storage systems will greatly enhance the attractiveness of such home solar installations and increase member-consumer interest and purchases. It may also diminish the consumer-sourced solar energy available to the cooperative. A cooperative should assess its members' demand for solar energy and how it can meet that demand.

1

Define Goals and Objectives

The essential first step in developing a solar program is to define the cooperative's goals and objectives, and identify associated needs and drivers. Some typical goals are listed below. In this phase, the cooperative should consider how renewable solar options fit within its strategic direction. The needs and interests of the overall membership need to be considered — not just potential member-subscribers, but how renewable options may benefit all members.

Strategic deployment of solar generation can aid grid integration and control.

- **Retaining and Enhancing the Member-Consumer Relationship:** A properly designed solar program can enable cooperatives to provide a cost-effective renewable solar option, thus promoting a positive public image and relationship with members and the community. A solar program provides the cooperative with an opportunity to interact with member-consumers in a positive way while offering them the alternative of working with a trusted supplier.
- **Meeting the Member-Consumer's Needs:** By offering solar systems, the cooperative can serve those member-consumers wanting a renewable energy option while guiding solar development in an effort to maximize the benefits for all its members. For instance, strategic deployment of solar generation can aid grid integration and control. Working actively with consumer-members on solar systems can also help to ensure that the power generated is delivered to the utility in compliance with current power contracts while retaining fair and equitable rates.
- **Meeting Policy and Regulatory Obligations:** In states that have enacted renewable portfolio standards, a cooperative solar program can enable the cooperative to meet these standards and goals. Just as important, the information and experience gained can position the cooperative to help guide public policy with facts and figures, and potentially stave off policy changes that may not benefit the co-op, its business model, or its members.
- **Economics:** With the decline in solar costs, solar generation is approaching a level that can compete with conventional energy resources. A solar program for member-consumers can offer the best of both worlds — a mix of alternative power supply resources and cost-effective alternative solutions that can increase their loyalty.
- **Targeted Infrastructure Upgrades:** Selective placement of solar generation to support the co-op's distribution system can leverage surrounding system upgrades and benefit all members.
- **Energy Efficiency Programs:** Engaging with homeowners interested in solar also offers an opportunity to integrate new technologies for an improved energy efficiency program offering, thus providing better economic returns to those homeowners.

2

Assess the Demand and Business Case

The third quarter 2016 report from Smart Electric Power Alliance (SEPA, formerly the Solar Electric Power Association) found that national residential solar prices averaged $2.98 per watt (DC), with non-residential system pricing at $1.69/watt (DC). This declining cost is corroborated by SEPA/GTM Research, as shown in Figure 3.

Using these average costs, a typical cost for a 5-kW AC home solar system can be expected to be roughly $15,000 to $20,000 (after adjusting for the inverter conversion from direct to alternating current — DC to AC). In addition, tax incentives play an important part in solar economics. The Federal Investment Tax Credit (ITC) can reduce costs by 40%; if a system is "business related," accelerated depreciation deductions (MACRS) may also be possible. For a typical system, if the deprecation deduction (business-related installations only) is feasible, the combined current tax incentives (ITC and 5-year MACRS) can reduce the capital cost by more than 50%. The sample economics might be as follows:

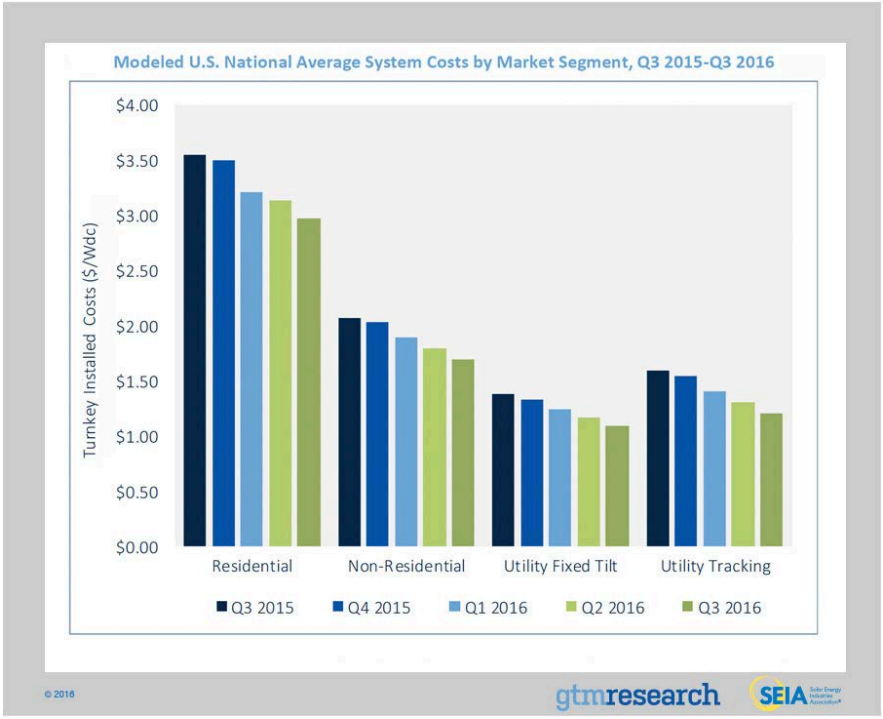


Figure 3: Modeled U.S. National Average System Costs, by Market Segment, Q3 2015–Q3 2016. http://www.seia.org/research-resources/solar-market-insight-report-2016-q4

- The 30% ITC, which can amount to $4,500 to $6,000, *plus*
- The 5-year MACRS depreciation allowance, which can provide a further tax benefit of roughly $3,500 to $5,000 (if the solar system is business related), *resulting in*
- A levelized cost of 11.1¢/kWh (see **Table 3** for more detail).

Despite these tax incentives, the large investment for a residential system may still require financing; those cooperatives developing a solar program that might require consumers to pay for the solar system may need to consider some type of financing to lower the financial hurdle for homeowners. Such financing could also provide a competitive advantage for cooperatives and their members.

In the past, solar financing has been a lucrative source of revenue for third-party developers, but banks are becoming increasingly more comfortable with providing homeowner loans for solar systems at lower interest rates. Consumer-owned rooftop solar estimates for 2016 were almost equal to third-party-owned systems; GTM estimates that in 2017, the majority of residential rooftop systems installed will be owned and financed by homeowners.

In this new world, cooperatives will need to evaluate their competitive position; a first step should be a review of the co-op's residential and commercial rate structures to determine how well they represent actual costs. The cooperative then should assess demand through a preliminary market study, which should identify existing and potential third-party solar installers, and analyze their offerings to consumers.

NRECA's ***Community Solar Playbook*** offers a great deal of detail regarding marketing studies. As a start, cooperatives should try to answer the following questions:

- What is the level of interest in and awareness of solar energy and community solar among the cooperative's member-consumers?
- Who is likely to participate in a solar program?
- Are existing companies already in the cooperative's service territory and marketing solar systems to cooperative member-consumers? If so:
  - What are the specifics of the competitor's offerings?
  - What are the economics (cost/benefit to the member-consumer)?
  - Have there been significant consumer complaints about or government investigations into any of the companies?
  - Are member-consumers satisfied?
  - What are the installing companies telling member-consumers about:
    - Their product?
    - The cooperative?
- How is the cooperative rate structure vulnerable to third-party solar offerings?
- What are the applicable member-consumer trends and preferred technology choices?
- What motivates member-consumers to participate?
- How much are they willing to pay?
- What are the service needs and expectations for a solar program?
- What is the competition doing (offerings, cost, sales pitch)?
- What, if any, negative perceptions regarding the cooperative — or a solar program — need to be addressed?
- How do consumer-members regard the co-op's rate structure (negative, positive, or neutral)?
- Is solar generation feasible in the local climate?
- Are third-party solar suppliers able to offer an attractive product to consumers?
- Should the cooperative partner with local solar suppliers to offer a quality product?

An example of marketing study information that may be helpful in designing a program can be found in Figure 4, from a **June 2016 National Renewable Energy Laboratory (NREL) webinar**.

Adopter motives for considering solar: money, environment, technology, leadership...

	Motive	"Extremely Important"
#1	Lowering your total electricity costs	78%
	Getting a good return on investment	33%
	Adding to your home's market value	23%
#2	Protection from rising electricity prices in the future	62%
#3	Being able to use renewable energy	50%
	Being able to use a promising new technology	30%
#4	Reducing your environmental impact	43%
	Setting a positive example for others in your community	26%

NATIONAL RENEWABLE ENERGY LABORATORY

Figure 4: Adopter Motives for Considering Solar

3

Designing the Solar Program

The cooperative's goals and objectives should shape the design of a solar program; its further definition will evolve during the development of the business plan, described below. However, before selecting a PV rooftop program, the co-op should consider the whole suite of solar options to make sure rooftop solar is the best fit.

1. Incentive Programs

An incentive program can offer rebates, loans, special rates, technical assistance/guidance, etc. for renewable solar installations. An incentive program provides an opportunity to engage member-consumers before and during the solar system selection process to make sure they understand the implications, costs, and installation criteria that must be met. This engagement can help member-consumers make an informed decision and reduce impacts resulting from installed generation not meeting distribution system standards.

2. Cooperative-Installed Solar Systems Owned by Member-Consumers

In this type of program, the cooperative supplies, designs, and installs the solar system, and the member-consumer pays for and owns it, often through financing provided by the cooperative. Typically, the output of such a system reduces the member-consumer's demand, thus reducing the monthly bill. Excess generation not consumed at the site is fed back into the grid, and the member-consumer receives payment for that surplus power. As a result, such a program can provide the homeowner with a quality system that meets the cooperative's technical criteria. It also provides the cooperative with an opportunity to weed out inappropriate installations, such as shaded roofs or locations on weak feeder lines, which might negatively impact the local distribution system.

The cooperative can also leverage its purchasing power, staff capability, and administrative infrastructure to offer savings to member-consumers. Perhaps most important, the cooperative remains the "face" of the member-consumer's power supply and can be held responsible for service issues, whether they arise from the solar system or some other part of the grid. This approach can also increase the accuracy of information communicated to the consumer-member about the system.

3. Cooperative-Owned Solar System, with a Roof Lease

In this type of program, the cooperative installs individual solar systems at each participating homeowner's site. The cooperative pays for and owns the solar system, and essentially pays rent for use of the member-consumer's property. The solar generation can either offset the member-consumer's usage or be metered directly to the grid, with the homeowner receiving a defined monthly payment. This program may be applicable when a cooperative needs additional generation and leases the member-consumer's rooftop or commercial overhead lot for solar installations owned by the cooperative. Although it may not have the same efficiencies of a much larger and more centralized utility-scale solar array, a community system can enable the cooperative to provide an opportunity to partner with local solar vendors/installers. The cooperative can also select where and how much generation to place in a particular area, depending on its system needs and capabilities. As remote control technology improves, the ability to control cooperative-owned solar generation can provide generation management and reactive power support. A key benefit of this option is the ability to offer member-consumers an alternative to net metering.

4. Cooperative-Managed and Third-Party-Administered Program

In this type of program, the cooperative uses a white-label platform to manage the entire solar adoption process, including design and installation, and the consumer pays for and owns the system, often with financing provided by the cooperative. The only difference is that a third party administers the program, with local installers bidding for individual projects and the cooperative having complete oversight control. It provides the cooperative with an opportunity to filter out any sites that do not have a good solar resource, such as homes with shaded roofs or locations on weak feeder lines that may negatively impact the local distribution system.

The cooperative can also leverage its purchasing power, staff capability, and administrative infrastructure to offer savings to the homeowner. Perhaps most important, the cooperative remains the "face" of the member-consumer's power supply, rather than relying on any one installer; at the same time, it helps to avoid dealing with any complications that may arise during the installation process.

5. Partner with a Third-Party Installer

Partnering with a third-party installer enables the cooperative to quickly and easily enter the solar business, remain the "face" of the consumer's power supply, and respond to consumer-members' desire for solar energy — all with minimal investment.

This approach gives the cooperative more control over the quality of installations and establishes technical criteria for installation that best meet the distribution system's needs and capabilities. The cooperative may also offer the option of providing financing to member-consumers, furthering its bond with them, or arranging for financing by other sources.

6. Community Solar Program

In a community solar project, the cooperative elects to build a solar project that allows its member-consumers to participate. Interested member-consumers can then purchase a share in the project. From the production of power from the project, the member-consumer would then receive a proportional share of the electricity produced, based on his/her purchased share(s) of project ownership. The quantity of power generated by the project is allocated to each member-consumer who owns shares, and an amount proportional to those shares is credited to that member-consumer's bill as if the generation had occurred at that consumer's location. At the same time, a proportional share of the operating costs of the project can be deducted from the credit.

A community solar program will typically offer consumers the lowest cost for solar generation, due to its economies of scale and the ability to site the generation in optimum locations (or where it can provide more benefit to the distribution system). The program can be sized in accordance with consumers' willingness to participate. Participation can be structured in different ways — for instance, by requiring upfront payments or having the cooperative elect to provide financing for the subscribers.

7. Rate Structure

The most powerful tool available to the cooperative in developing a program to meet the challenge of solar generation likely is its rate structure. Revising the rate structure to more closely match fixed and variable costs can eliminate false price signals to member-consumers and address much of the cost-shifting problem that can result when members adopting private solar do not bear their fair share of fixed costs.

Rates that more closely match costs allow the cooperative greater flexibility in designing and promoting a solar program that encourages solar generation. For instance, the cooperative could modify its net metering rate to better reflect a program's real economics and mitigate some of the cross-subsidy issues with non-solar consumers.

BUSINESS MODEL CHECKLIST

The co-op must be able to provide member-consumers with a solar program that can reasonably satisfy their preference for solar energy. In designing the offering, two of the more critical decisions will involve (1) selecting the right business partners for equipment, sales, installation, etc., to achieve a competitive quality product; and (2) structuring the economics of the offering to the member-consumers.

In deciding on the business model, the checklist shown in **Table 2** may be useful in identifying the tasks that each model might entail.

Table 2: Business Model Checklist

Example Business Model Tasks		Co-op Owned and Installed		Co-op/Third-Party Installed and Member Owned		Co-op Financed	
		Co-op	Third Party	Co-op	Third Party	Co-op	Third Party
DEVELOP BUSINESS PLAN	Develop Value Statement	•		•		•	
	Perform Market Analysis	•		•		•	
	Do Risk and Mitigation Planning	•		•		•	
	Choose Model	•		•		•	
	Check Research and Regulatory Requirements	•		•		•	
	Perform Financial Economic Analysis	•		•		•	
	Obtain Approval	•		•		•	
PROGRAM IMPLEMENTATION	Establish/Contract with Partners	•		•		•	
	Develop Marketing Campaign	?	?	?	•		•
	Develop Sales On-Boarding Process	•		?	•		•
	Implement and Test Software	•		•	•		•
MARKETING PROGRAM	Conduct Initial Marketing	•		?	?	?	?
	Capture Member-Consumer Interest	•		?	?		•
	Conduct Secondary Marketing Campaign	•		?	•		•
PRE-SALE TASKS	Perform Rooftop Review				•		•
	Do Credit Review (if doing financing)	?		?	?		•
	Perform Community Solar Comparison	•		•			•
	Sign Contracts	•		?	?		•
INSTALL SYSTEM	Do Physical Installation	•			•		•
	Obtain Codes and Standards Review/Approval	•			?		•
	Do Interconnection	•		?	?		•
RECORD KEEPING	Billing	•		?	?	?	?
	Power Production	•		•		?	?
MEMBER-CONSUMER MAINTENANCE	Operation and Maintenance	•		?	?	•	
	Customer Service	•		?	?	?	?
	System Replacement/Removal	•			•		•

Breakdown of task responsibilities between cooperatives, third parties, and others for each business model. This table is an illustrative tool showing who performs different tasks and can be modified as needed.

Residential PV Program Models and Options

Once a cooperative decides to pursue a residential PV program within its strategic framework, the following questions should be considered in deciding the general structure:

1. How much solar generation is the cooperative willing or able to absorb into its system before the quantities become problematic? The location and amount of solar generation may be limited by:
    a. Distribution system limitations (i.e., weak or strong feeder lines)
    b. Contractual issues (i.e., power supply contracts, G&T tariffs)
    c. Economics (i.e., solar costs are much higher than avoided costs)
    d. Federal, state, or local requirements
    e. Other constraints

2. Should the solar program offer community solar, individual homeowner solar systems (rooftop or ground-mount), or both options?

3. Should the cooperative or the subscribing member-consumers own the solar systems?

4. If the cooperative owns the system, should it:
    a. Lease the systems to the member-consumers and have them receive the benefit through reduced billing (so the member-consumer takes the risk of lost generation)?
    b. Offer power purchase agreements, wherein the cooperative pays a set rate for all generation from the system?
    c. Lease the rooftop or ground site and pay the homeowner a fixed monthly rate for the use of the premises?

5. If the member-consumer owns the solar generation:
    a. Should the cooperative allow net metering or not? If so, what type?
    b. How much should the cooperative pay for the solar power:
        i. Avoided cost?
        ii. Spot market?
        iii. Subsidized rate?
        iv. Retail rate?
    c. Decide what terms to offer for the power:
        i. Buy all — sell all? (In this format, the cooperative pays for all kWhs produced, and the member-consumer pays the retail rate for all kWhs consumed at the site.)
        ii. Payment for energy produced — how much? Net metering?

6. Should the cooperative offer direct financing?
   a. If so, at what rate and terms?
   b. What are the effects of such financing on the cooperative's financial statements?
   c. What are the federal and state laws on consumer financing?
7. Should the cooperative set up third-party financing for consumers?
8. How can the cooperative monetize the tax incentives? (See sidebar "Monetizing Tax Incentives.")
9. Who gets the Renewable Energy Credits (RECs)? Does the member-consumer or the cooperative retain the RECs, either to sell or use them to meet a renewable energy portfolio requirement or goal?
10. Should the cooperative partner with a third-party installer or keep the system development and installation in house, with cooperative staff installing and maintaining the solar installation(s) similar to how it currently operates its distribution system?
11. What are the legal and regulatory implications of a solar program? For instance, does the program comply with state regulatory requirements? Could the offering be considered a sale of securities, which could involve federal and state regulations?

MONETIZING TAX INCENTIVES

If the cooperative expects to provide financing, as a not-for-profit entity, it must address the issue of tax incentives, which its for-profit competitors can more easily leverage. The ability to monetize the 30% ITC and the 5-year MACRS depreciation are major cost components in the solar business case.

Fortunately, there are methods to address these challenges, but they involve partnerships with taxable entities.

There is also the potential for applying for New Clean Renewable Energy Bonds (NCREBs) and Rural Energy for America Program (REAP) grants. However, the current low interest rates have reduced the economic value of the NCREBs. Also, the REAP grant applications take time and cannot always be relied on with certainty for planning purposes.

Options to monetize the tax incentives include the following:

a. Doing a tax equity flip with a partner
b. Establishing a lease buy-out with a taxable entity
c. Leveraging a taxable subsidiary
d. Having member-consumers own the solar systems and provide the tax appetite

These questions do not make up a complete list but should provide a forum to begin identifying the needs and goals of the cooperative and its member-consumers, and designing its solar program.

The cooperative should undertake a legal and regulatory review of the program as part of the development of the business case to avoid missteps or setbacks.

The cooperative should undertake a legal and regulatory review of the program as part of the development of the business case to avoid missteps or setbacks.

In working through the questions above, the cooperative needs to look at its individual circumstances and select a starting path. A residential solar program can be tailored in several ways but should strive to meet the needs and desires of the participating member-consumers while still addressing the interests of other members.

Alternatively, a community solar project allows any of the cooperative's member-consumers to participate in a solar project, not just those fortunate enough to have a roof that is unshaded or with the right orientation. Ownership of the solar array is shared among those member-consumers electing to participate in its financing. A community solar project can be sized based only on those member-consumers willing to participate; a cooperative also could size it to be somewhat larger, with the surplus available for its other needs or for future participants.

A community solar project allows any of the cooperative's member-consumers to participate in a solar project, not just those fortunate enough to have a roof that is unshaded or with the right orientation.

Finally, developing an MW-scale project may be the best option, as it enables the cooperative to evaluate closely the economics and determine the optimum size and location for a solar project to fit into its power supply. Depending on economics and system needs, a utility-scale solar project can enable the cooperative to bring solar into its portfolio and demonstrate the technology to its member-consumers.

This option is the simplest approach to meeting portfolio standards and fits within the historic cooperative model of providing power supply to its member-consumers. It provides flexibility in designing and locating the solar resource(s) to provide distribution grid support and capital investment deferral. This option is also likely to be the most efficient, due to its greater economy of scale. Also, the benefits of a utility-scale project accrue to all member-consumers, not just those able to afford a homeowner system.

Each of these approaches requires considerable staff resources to develop. This demand on staff resources can be mitigated by third-party partners, who can carry much of the workload. Also, the co-op needs to recognize that the business case for each approach is very different and must be evaluated independently (each option likely with different players) based on its specific circumstances.

Developing the Business Case

In developing the business case, the goal is to capture the following:

1. The strategic rationale for the program
2. The program's:
   a. Goals
   b. Overall value proposition
   c. Success factors
3. The proposed scope, scale, and technology
4. The proposed software strategy
5. The proposed financing strategy
6. The proposed marketing strategy
7. The consumer value proposition
   a. Program pricing to member-consumers
   b. Expected member-consumer participation
   c. A plan for member-consumer care
8. The estimated project size
9. A regulatory and legal overview

The strategic rationale for the program will guide the goals and objectives cited above. The rationale, goals, and objectives should be communicated clearly to cooperative personnel involved in the program so they have a good understanding of why the cooperative is engaging in this process. Staff support of the program is crucial to its success and should be established early on.

In turn, the goals and objectives will guide the proposed scope, scale, and technology for the program. At this point, the co-op should develop a "pro forma" economic model, including costs and savings (i.e., offset power purchases), to provide insights into what factors (i.e., capital expenditures [CAPEX], ITC, interest, financing costs, solar production, etc.) are important, and how they interact in the overall economic context. As an example, a relatively sophisticated analysis — the SUNDA Solar Costing Financing Screening Tool — can be found on the NRECA webpage for the Solar Utility Network Deployment Acceleration (SUNDA) project.

To develop the business case for a solar program, the cooperative needs to understand the value proposition for both the cooperative and its member-consumers.

The cooperative also needs to understand how a solar program will affect its overall economics. The costs and delivery pattern of solar generation may or may not fit well with the cooperative's system and needs. Developing the business case will help the cooperative better understand the benefits and costs of solar generation.

In developing the business case, these steps may be helpful:

Step 1:

Determine the costs for typical individual homeowner systems and larger commercial systems. In addition, identify the potential for various federal, state, and local incentives, as well as any opportunities for the cooperative to take advantage of these incentives, such as the federal ITC.

Step 2:

Using free solar calculators, such as PVWatts, get a sense of the available solar resource and its generation pattern for the cooperative's locale.

Step 3:

With the system costs and expected annual generation now calculated, the cooperative can get a rough idea of the cost/kWh.

Step 4:

Compare this cost and the timing of the generation with the cost of offsetting power purchases (avoided costs) or alternative generation.

Step 5:

Assess the influence of non-economic strategic drivers, and whether those drivers add sufficient "push" to overcome any identified economic hurdles.

Completion of these steps should be considered a decision point in the "screening" phase to decide whether to continue with the development of a business case. Assuming this phase shows the potential to proceed, the co-op needs to conduct a deeper analysis into the economics of such a program.

REVIEWING BUSINESS CASE ECONOMICS

The cooperative should follow similar steps when reviewing the business case economics.

Step 1:

Based on the alternative ownership model, determine the total cost of the program, including capital and operating investments.

Step 2:

Determine the revenue recovery streams, including the ITC and any recovery from member-consumer investments or rates.

Step 3:

Model the economics to determine internal rate of return (IRR), net present value (NPV), or payback year.

Step 4:

Model the financial impacts through a cooperative financial forecast, modeling the timing of investments, revenue recovery, and the overall impacts on financial ratios.

Step 5:

Analyze use-case scenarios related to changes in assumed production or demand.

Step 6:

Document and summarize the conclusions.

Additional Business Case Planning Considerations

Assessing the cost and solar resources is just the first step. The cooperative also should consider the following important items.

MARKETING

Marketing is a critical element of planning but can require significant staff time and investment to be done successfully. More information on this topic is provided in Section 4.

SOFTWARE

Concurrently, the cooperative needs to identify its proposed software strategy and how it will integrate the various aspects of the program, such as member-consumer billing. Billing for a solar system likely can be integrated into the cooperative's billing system, but this process will require modifications of existing or legacy software. Typical billing algorithms might include straight monthly charges, credits for surplus kWhs delivered to the grid, debits for maintenance calls, etc. These items all are common to most billing systems, but the cooperative's IT personnel need to be engaged early in the design of system components and software/hardware selection.

FINANCING

Depending on the approach taken, the costs of solar programs can vary greatly. Some programs require little investment, and existing staff can incorporate the work involved into their existing duties. However, if the program involves financing of solar

systems, the capital cost of the systems can be high, so the cooperative needs to address significant funding issues, whether it owns the assets or helps program subscribers with financing arrangements.

Tax incentives need special attention because they play a major role in the economic viability of a solar program.

In this case, the cooperative's finance staff should be consulted early to determine the impact of the program on its finances. Finance staff should be provided with estimates of capital costs and expected cash flow so they can arrange the financing and provide estimates of interest costs and other financing terms needed for the program's pro forma.

The financial aspects of a solar program are driven by its capital costs, the tax benefits, interest rates, and production. Of the major cost components, tax incentives need special attention because they play a major role in the economic viability of a solar program, whether or not the cooperative owns the solar assets. State or local incentives often are available, but the two major current tax incentives are federal:

Note: If a member-consumer takes out a home equity loan to finance the solar system, the interest on that loan may be deductible.

- **Federal Investment Tax Credit (ITC):** Solar projects under construction by December 2019 will fully qualify for the 30% ITC. (Note: The investment credit will fall to 26% for projects starting construction in 2020 and 22% for projects starting construction in 2021.) After 2023, the residential credit will drop to zero, whereas the commercial and utility credit will drop to a permanent 10%.

- **5-year Modified Accelerated Cost Recovery System (MACRS):** In addition to the ITC, solar assets also qualify for a 5-year MACRS depreciation treatment. This tax benefit can be worth as much as 20% of the initial investment and reduce the cost of power from the solar project.

To take advantage of these incentives, either the cooperative or the member-consumer must have taxable income or a "tax appetite" against which to apply these incentives. Given the typical cooperative's tax-exempt status, it may need to partner with a taxable entity to monetize the incentives.

A final note of caution — the tax laws regarding renewable energy are very complex, so the cooperative should take care to avoid disqualifying events. Consultation with tax professionals knowledgeable about renewable energy is important.

COOPERATIVE FINANCE OPTIONS

National Cooperative Bank (NCB), with assistance from the **National Rural Utilities Cooperative Finance Corporation** (CFC), now offers a national retail solar financing program that electric distribution cooperatives can offer to their consumer-members. "This value-added service provides another way for electric cooperatives to engage with their consumers and support renewable initiatives," said CFC Senior Vice President of Business and Industry Development Greg Starheim.

Consumers will access NCB, a national financial institution that focuses on cooperatives and their members, through a web portal linked with participating electric cooperatives. NCB will underwrite both consumer loans for community solar subscriptions in projects owned by electric cooperatives and home equity loans for the purchase of behind-the-meter rooftop or backyard ground-mount distributed generation (DG) solar systems. The finance program is an alternative to cooperatives incurring on-balance sheet funding through either direct loans or special tariffs to support renewable energy solutions.

For more information, contact Linda Graham with CFC at 800-424-2954 or **linda.graham@nrucfc.coop**.

4

Marketing the Program

To develop an effective marketing effort, the cooperative needs to look at the business case for member-consumers and demonstrate its value proposition to them, showing how it is a better option than other solar offers.

Any discussion on cost savings should be conservative in estimating savings.

It is important to assess, by consumer segment, the economics, potential demand, and participation factors. The NRECA's ***Community Solar Playbook*** provides more detail on market assessment, but some basic parameters to consider in looking at the business case for member-consumers are as follows:

- Who is likely to participate?
- Is the motivation economic (savings) or environmental?
- How much are they willing to pay to participate in a solar program?
- What other options are available to member-consumers (offerings, cost, sales pitch)?
- How much could the member-consumer save with the current rate structure?

Other factors, such as environmental considerations, a desire for energy independence, and energy security can be motivators for member-consumers.

For member-consumers to embrace the solar program, the value proposition needs to be defined and communicated. When existing rates are high and a good solar resource is available, there may be a potential for member-consumer savings. In that situation, the marketing focus can be on the potential savings — a strong incentive for most member-consumers. However, any discussion on cost savings should be conservative in estimating savings.

Alternatively, the potential for savings is minimal or negative in many areas; if so, the co-op may need to address cost-shifting. In these cases, the marketing emphasis should be on non-economic drivers, such as environmental considerations, a desire for energy independence, and energy security. These factors can overcome the lack of savings and still motivate member-consumers to participate in the program.

Cooperatives have an advantage in marketing to their member-consumers, in that they already have a marketing program, including newsletters, advertising, and direct consumer-to-cooperative contact. The solar program can be marketed through these channels, leveraging the cooperative's strengths at little or no incremental cost.

The cooperative's online tools also can be tailored to the solar program. They can encourage member-consumer self-education, shorten the sales cycle, and even create excitement around the program. Because potential competitors are likely to use websites and online tools, along with call centers, having a cooperative online presence can keep it visible as member-consumers shop for solar generation. Developing a persuasive online presence and tools requires some

sophistication, so cooperatives should investigate appropriate third-party partners because they may offer significant savings in time and resources. For instance, they may be able to customize existing online tools for the cooperative's solar program.

Participating in local, inexpensive events, such as farmer's markets or craft shows can also raise member-consumers' awareness of the cooperative's solar program. Often, cooperative personnel already are participating in these events, and face-to-face contacts can be a great way to promote the program. The marketing module of NRECA's ***Community Solar Playbook*** is also a good reference to consult for guidance and ideas in marketing the solar program.

Costs will vary depending on individual circumstances. Each cooperative must make its own independent business decisions regarding pricing.

For homeowners, rooftop solar programs will work best if the following conditions exist:

1. Electricity prices are high
2. The cost of solar and financing is reasonable
3. The site has a good solar resource

A lack of any of these parameters can make the economics difficult for a solar program, which may require support in the form of subsidies, grants, or cost-shifting to other non-solar member-consumers.

Because the cost of equipment is similar for most installations, the three factors most likely to influence cost variations are the following:

1. Electric rates – The higher the utility rates, the more potential for savings from solar
2. Local incentives – These incentives vary from state to state and can make the difference between an economically viable and unviable choice
3. Solar radiance – The Southwest U.S. will have more sunny days than the Northeast, resulting in greater production from a system of the same size; the impact on the economics can be significant

Although other factors affect the cost/kWh, those listed above usually have the greatest impact and should be investigated thoroughly. The prices shown in **Table 3** are hypothetical examples intended only to assist cooperatives in gaining a better understanding of the potential calculations involved with solar systems. (For simplicity, interconnection costs, operation and maintenance (O&M) costs, or possible depreciation benefits are not included.) Costs will vary depending on individual circumstances. Each cooperative must make its own independent business decisions regarding pricing.

As the examples in Table 3 indicate, the cost per kWh for solar generation declines as size increases. This same economy-of-scale principle holds for residential systems; the larger the system, the lower the unit cost, because the fixed costs of customer acquisition, overhead, equipment, system design, etc., amount to several thousand dollars for each site. Those fixed costs do not change with the size of the rooftop installation. In comparing an 8-kW system to a 4-kW system, the unit cost per watt for the larger system will be less than the smaller one. Although the overall cost for a larger system will be higher, the total cost will not rise as quickly as the increase in size. For this reason, small systems — i.e., 2 kW — are much less cost-effective.

Note also that the examples on cost per kWh shown in **Table 3** are likely to be higher than the numbers a solar system installer might use in a sales pitch. For example, the sales person might tell a consumer that solar would cost less than 7 cents/kWh, using the following calculations:

- Assume that each watt of a system will produce 1,500 watt-hours per year (1.5 kWhs/yr); this assumption would be based roughly on an 18% capacity factor

Table 3: Typical Costs for Solar Systems

	Residential Rooftop Solar	Commercial Rooftop Solar	Community Solar Project
Size of System	5 kW	25 kW	200 kW
Cost of System	$15,000 (assumes $3.00/watt AC)	$68,750 (assumes $2.75/watt AC)	$450,000 (assumes $2.25/watt AC)
30% ITC	$4,500	$20,625	$135,000
Net Cost after ITC	$11,000	$48,125	$315,000
Annual Payment: 20 years @ 5% interest	$876/yr	$3,678/yr	$24,073/yr
Panel Efficiency	18%	18%	18%
Annual Production kWhs/Yr	7,884 kWhs/yr	39,420 kWhs/yr	315,360 kWhs/yr
Cost of Power	$876/7,884 = $0.111 or 11.1¢/kWh	$3,678/39,420 = $0.093 or 9.3¢/kWh	$24,073/315,360 = $0.076 or 7.6¢/kWh

- 1.5 kWhs per year times a 25-year life will equal 35.5 kWhs for each watt of the solar system
- Thus a 5,000-watt (5-kW) system will produce 37.5 kWhs x 5,000 = 187,500 kWhs
- Assume a 5,000-watt system costs $3.00/watt ($15,500), and the 30% ITC will reduce the capital cost to $11,000
- Dividing the $11,000 by 187,500 kWhs = 5.8 cents/kWh

Although this sales pitch calculation is mathematically correct, it does not take into account the interest costs, time value of money (interest that could have been earned by the money spent), or O&M costs. In effect, the sales pitch may underestimate the actual cost to the member-consumer (who also may not have a sufficient tax appetite to take full advantage of the tax credit).

Community-scale solar systems are generally much more cost-effective than rooftop systems due to their economy of scale. Even small community solar arrays are typically larger than those installed on residential and commercial rooftops, and they can be optimally sited both to capture sunlight and for interconnection with the existing electric infrastructure.

Community arrays can be scaled based on consumer interest. Also, because all generation goes onto the grid, they provide more reliable and predictable generation from the standpoint of the local utility, which can integrate this solar capacity into its resource and reliability planning.

Finally, the utility or a contracted third party takes care of all installation, operations, insurance, and maintenance. This arrangement makes community solar more cost-effective, offering more "bang for the buck" and providing a win-win situation for all ratepayers.

With their lower cost per watt, community solar programs can provide a solution to the challenge of cross-subsidization by covering the full costs of solar deployment through the voluntary participation of subscribers.

In designing the solar program, the economy of scale offered by community solar may provide the most economical

way for consumers to participate in a solar program. In addition, many member-consumers are unable to participate in a homeowner program, such as those who are apartment dwellers or whose homes are shaded or wrongly oriented. Community solar allows those consumers to participate in a solar program.

At this point, the cooperative should have a general sense of what it wants to accomplish with a solar program, and what that program should look like. The solar program offering needs to clearly define its terms and economics so they can be easily conveyed and member-consumers can understand what is being offered and how it affects them. For more information on marketing solar programs, including example marketing materials, see NRECA's ***Community Solar Playbook***, Module 2.

Adapting the Solar Program to Local Conditions

If the retail rate is based solely on kWh sales and is higher than the cost of the rooftop solar, the member-consumer will find the solar option attractive. Also, if the cooperative's avoided cost is equal to or greater than the cost of solar, both the cooperative and the member-consumer will benefit from the solar generation, and a solar program can be justified easily. In this case, net metering offers a simple structure for recovery of solar costs. However, the co-op still needs to clearly communicate the following information to all member-consumers:

- The billing rate structure, and how self-generation reduces the bill
- When generation exceeds load, the concept of "banking" the power, or reimbursement
- How the reimbursement rate is determined
- Potential for cost-shifting, as described further below

COST-SHIFTING

Cost-shifting occurs when a member-consumer's billing does not recover the cost of serving that member.

For example, assume a co-op's fixed cost is $15/kW-mo and its variable cost for variable energy is 5¢ per kWh. Its average member-consumer takes 1,000 kWhs/mo and contributes 4 kW to its peak demand. Thus, the cost of serving that member-consumer is $110 per month ([$15/kW-month x 4 kW] plus [5¢/1,000 kWhs]). Because typical residential billing structures often are based only on kWhs, dividing that $110 by 1,000 kWhs yields a "kWh-only" billing rate of 11¢/kWh.

Cost-shifting occurs when a consumer installs self-generation that does not reduce peak demand. If a consumer's 5-kW solar system generates 700 kWhs during the month, the bill is only $33, based on the kWh-only rate for the remaining 300 kWhs. Also, the consumer's 4-kW actual demand on the system has not changed because the consumer's peak demand often occurs after sunset, when the solar system is not generating.

For that month, the co-op's cost of serving that member-consumer was $15 x 4-kW peak demand, plus 5¢ x 300 kWh = $75. The $42 difference between the $75 cost and the $33 billed must be recovered from other consumers, or shifted. As a result, the solar-owning member-consumers do not pay their share of the cost of service; those costs are borne by the non-solar member-consumers — in other words, a cost shift.

Cost-shifting can lead to lower-income member-consumers subsidizing wealthier member-consumers, who are more likely to have the financial resources to install distributed generation (DG)/ distributed energy resources (DER).

However, it is more common for the cooperative's variable energy costs to be lower than the cost of the solar, and that cost differential must be addressed. Also, even if the retail kWh-only rate is equal to or higher than the average cost of a consumer system, a portion of the cooperative's costs are fixed (i.e., distribution system, back-up generation, maintenance, etc.), and those costs also must be recovered.

If the solar homeowner's fixed costs for electrical service are not recovered because the normal billing structure is based solely on kWhs, the normally expected kWhs for the home cannot be billed because they have been displaced by a home solar system. Because the fixed costs must still be recovered, that recovery often must come from non-solar member-consumers via the overall rates. The result is cost-shifting from the solar-owning to the non-solar member-consumer. (See sidebar on **cost-shifting**.)

This situation can lead to lower-income member-consumers subsidizing wealthier member-consumers, who are more likely to have the financial resources to install distributed generation (DG)/ distributed energy resources (DER). This presents a particular challenge to electric co-ops, given their higher distribution costs due to low density — especially those serving territories with areas of high or persistent poverty.

To avoid such cost-shifting, the solar program will need support from subsidies, grants, or the solar-owning member-consumers. In some cases, it can be argued that some of the lost fixed-cost revenue is offset by other benefits. For instance, in most areas, solar generation occurs during peak load periods, when power is more valuable. Thus, the value of the solar generation is higher because of its timing. Also, there is some evidence that solar generation located "at the end of the line" can reduce transmission and distribution losses. Some reduction in system demand is also possible, but often the peak hours are near or after sunset, when solar generation no longer contributes to demand reduction.

These issues are currently being hotly debated at various state regulatory levels, with opposing sides finding little common ground. Due to the unique characteristics of every cooperative and electrical system, detailed engineering studies need to be performed to quantify those benefits; even then, the value of those benefits may not fully make up for the cost differential. As a result, the development of a solar program often relies on the willingness of the cooperative's board of directors to support its costs.

To address the cost differential, a solar program may need to rely on the solar-owning member-consumer to absorb the additional costs. This approach can work if member-consumer interest is driven by factors other than economics, which often is the case. Those factors include intangibles, such as environmental considerations and a desire for energy independence and energy security.

Alternatively, many co-ops are moving toward covering much or all of their fixed costs through fixed charges, often called facilities, customer, or access charges. Most co-ops use at least some level of these charges, though in many cases they are not adequate to cover the fixed costs. The goal is to align rates with costs so that, to the extent possible, fixed rates cover fixed costs and variable rates cover variable costs due to usage. This strategy may be necessary to avoid undermining the maintenance of the distribution infrastructure.

Community solar programs can help to avoid cost-shifting by covering the full costs of solar deployment through voluntary participation.

NRECA's *51st State Report* suggests that the market structure should:

1. **Ensure that all distributed and renewable technologies are available to the interested member-consumer, and no one technology is promoted over any other**
2. **Provide transparency regarding the cost impacts and direct or indirect (hidden) subsidies between consumer classes associated with each technology**

Implementing fixed charges requires a clear rate strategy and effective communication. Also, these charges are often phased in to avoid rate shock and member unrest. Another option could be higher fixed charges or other standby or member-specific charges for member-consumers deploying self-generation. This would ensure fixed-cost recovery from these member-consumers for costs incurred to provide service and avoids shifting the fixed costs of serving them to others.

The *51st State Report* also notes that community solar programs can help to avoid cost-shifting by covering the full costs of solar deployment through voluntary participation. Even small community solar arrays are typically larger than those installed on residential and commercial rooftops, and can be optimally sited for the best solar resource and interconnection with the existing electric infrastructure. Finally, the utility takes care of all installation, operations, insurance, and maintenance. This arrangement makes community solar more cost-effective, again offering more bang for the buck and providing a win-win for all ratepayers.

5

Resources and Staff Tasking

Implementing a residential solar program involves numerous and varied tasks that will require the commitment of adequate resources to successfully develop, implement, and market the program to cooperative members. As member-consumers sign up for the program, the administrative capability to execute and document the required forms and agreements must be in place. Selecting the technology vendors and arranging for design and installation will require close attention, along with ensuring proper safety procedures. Finally, an ongoing maintenance and monitoring plan should be in place to ensure the continued success of the program.

Whether the actual design and installation of the solar systems is done in house or contracted out, the cooperative has ultimate responsibility for management of the program, including such activities as:

- The business case and value proposition for both the cooperative and its member-consumers
- Engineering design of the solar system and integration into the distribution system
- Project budget and projected cash flow
- Any financing
- Siting criteria
- Member-consumer participant criteria
- Design of the solar program specifics
- Marketing plan and communications with the cooperative's member-consumers
- Integration of the solar installations into the cooperative's IT and billing systems
- Risk and mitigation plan, including insurance
- Evaluation and selection of consultants, equipment, and installers

Evaluation and selection of consultants, equipment, and installers will be a key factor in the success of the program.

The last item — evaluation and selection of consultants, equipment, and installers — will be a key factor in the success of the program. Initial engineering and design of the solar system are often best outsourced to consultants with specialized skills. The initial decisions in evaluation and selection of the various equipment options will affect the solar program for many years, so guidance from experienced specialists is advised.

As internal skills and experience are developed, the cooperative's staff may be the best resource for managing and growing the program. Even then, some areas, such as the individual design of each rooftop installation, may best be outsourced to avoid staffing issues when workloads fluctuate.

The choice of performing installation with internal staff or using a contractor will depend on the available internal staff or the cooperative's willingness to expand its workforce to take on this work. Keeping the field work internal, perhaps with some contractor support, can help in maintaining the relationship bond with member-consumers and assist in maintaining quality control. Also, keeping the work in house will allow the staff to develop new skills and abilities while retaining "institutional memory" that can provide long-term value.

An installer that performs most of its own work may have better control of the job and its quality.

Alternatively, if the cooperative elects to partner with an installation contractor, the installer should have considerable experience in rooftop installations and a good safety record. References should be checked thoroughly and a random sample of several past installations should be inspected. Such inspections preferably should include an interview with the homeowners. Cooperatives should require contractors to be licensed and insured.

Sample questions when selecting a contractor might be:

- Can the contractor provide a list of credible references?
- How long has the contractor been installing solar PV systems?
- Are there solar PV systems available that can be inspected?
- How does the contractor handle warranties?
- Does the contractor use subcontractors? For what portions of the work?

The size of the installer is not necessarily important. The installer does not have to be a large company. Size does not guarantee quality or longevity — both large and small players constantly move in and out of the industry. Large installers will likely incur more overhead costs, whereas small installers may be more attuned to their member-consumers and familiar with the cooperative's service territory. More important, the cooperative should seek an installer that has been in business for several years and has a good reputation. Another factor to consider is whether the installer performs most of its own work or subcontracts much of it. An installer that performs most of its own work may have better control of the job and its quality.

If sales personnel are retained to market the program on a commission basis, be cautious about overselling the number of solar panels (known as "stuffing the roof"). A tiered sales commission based on various classes rather than actual dollars of installation may mitigate that risk. The **Appendix** includes a checklist of potential tasks and should provide an overview of most of those that cooperative managers should bear in mind as they consider a residential solar program.

Make sure that any contracts with third parties adequately reflect the design of the solar program. Also, if the cooperative member-consumer will be the owner of the equipment, it may be appropriate to ensure that language included in any third-party contracts would give the member-consumer the right to assert warranties or other rights under the contract.

6

Establish Agreements with Member-Consumers

Consumer-sited generation raises important legal, economic, and technical issues that the cooperative must address. NRECA has created a toolkit to help electric co-ops draft the rules, policies, tariffs, contract documents, and retail rates required to respond to member requests for interconnection. Available online, the ***DG Toolkit*** *includes a business and contract guide, model applications, model contracts, and relevant issue papers. These resources were developed for member-consumer-owned generation and should be adapted as necessary to accommodate the co-op's business model. Be sure to consult with an attorney to ensure that the contract adequately sets forth the roles and responsibilities of each party to the agreement. The length of time and effort needed to complete a contract with a member-consumer will depend on the site and whether the cooperative requires more information to complete its system impact analysis.*

The basic steps of establishing an agreement with a consumer are:

1. The member-consumer submits a complete application form.
2. The cooperative screens the application and location for fast-track interconnection.
   a. If the applicant passes the fast-track process, an interconnection agreement is signed and the system is installed.
3. If the fast-track screening fails, the application is submitted either for a supplemental review or full study process.
   a. The supplemental review checks for load, voltage, power quality, and safety and reliability.
   b. The full study process includes a system impact study and a facility upgrade study.
4. Once the reviews have been completed, the project is either rejected, approved, or approved pending system or facility upgrades. In some cases, this process may require homeowners to make upgrades themselves.

Considerations include the following:

- Establish a process that can respond quickly to member-consumer interest and enroll them in the program.
- Ensure that all local permits and applicable legal requirements are met during the engineering review.
- Agreements needs to cover:
  - Benefits of the program
  - Cost of program participation, including maintenance, if required
  - Length of the program
  - How to leave the program, if allowable
  - Who is liable for damage to the system
  - Recompense, if any, for system underperformance
  - Ownership of environmental attributes
- If an interested member-consumer is a poor candidate for a residential solar program, recommend alternative programs for them, such as community solar.

By operating a residential solar program, a cooperative has a unique opportunity to leverage additional value from the solar installations through advanced controls and inverter functionality. IEEE Standard 1547, which defines interconnection requirements for DER, is undergoing a major revision in 2017. Once the rule is finalized, these systems will likely be able to provide volt/VAR support and frequency response regulation, and integrate into smart, automated distribution systems. However, additional legal language and consumer compensation may be required to implement these controls. For more information on IEEE 1547, check out NRECA's four-part series: **https://www.cooperative.com/interest-areas/engineering/Pages/IEEE-Standard-1547.aspx**.

7

Program Execution

Executing a solar program involves a series of technical steps. This section presents one method to execute a solar program; however, other methods also exist and may be more suitable for your cooperative. First, the PV systems need to be engineered, installed, and interconnected, followed by setting up a billing system and integrating it into the existing IT infrastructure. Finally, the cooperative also needs to set up a process for monitoring the PV systems and maintaining member service.

This checklist provides more detail on steps to initiate a solar program.

- [ ] Review your state regulatory requirements to determine what criteria need to be met.
- [ ] Review your program with an attorney knowledgeable about federal securities law to make sure the program either is exempt from or in compliance with laws regarding securities offerings.
- [ ] Consult an attorney regarding federal and state consumer lending laws if you plan to make a loan to your member-consumers.
- [ ] Visit with your state and local permitting authorities to determine what permits are required to install solar systems.
- [ ] Investigate the potential for renewable energy grants or incentives that may be available from state or local entities, including organizations promoting renewable energy.
- [ ] Ensure that your designers and installers know and understand the electrical, building, and safety code requirements for solar systems.
- [ ] Coordinate the solar program with the G&T if applicable.
- [ ] Engage your engineering personnel to identify the following:
  - Distribution system issues
  - Interconnection requirements
  - How the addition of solar might affect the system (typical issues might be weak feeders, reverse power flow, relay setting, etc.)
  - Required criteria for allowing interconnection of solar systems to the distribution system
- [ ] Contact your insurance company to determine what insurance is needed for your solar program.

- [ ] Confirm that the contractor installer is licensed and insured.
- [ ] Coordinate with the cooperative's finance personnel to address the following:
  - Financing of solar systems when solar assets are owned either by the cooperative or member-consumers
  - Effect of the solar program on the cooperative's financial statements
- [ ] Engage your IT personnel to determine how the solar project will interface with the cooperative's computer systems, including the following examples:
  - Distribution system software (i.e., SCADA, relay monitoring, etc.)
  - Billing software
  - Data acquisition, monitoring, and control for the solar systems and individual panels (generation, voltage, output tracking, etc.)
- [ ] Research the equipment costs and warranties, along with projected installation and O&M costs.
- [ ] Develop a plan for maintenance, including the following:
  - Cleaning panels in areas with minimal rain
  - Replacing failed components (primarily inverters)
  - Which cooperative personnel should serve as the member-consumer contacts
- [ ] Design the various systems, considering the following:
  - Identify staff or consultants to design individual systems
  - Identify staff or consultants to evaluate and select components for a standardized system
  - Ensure that the selected systems/components meet insurance requirements and are UL approved
  - Decide if/how to structurally evaluate roofs to support a solar system

Engineer, Install, and Interconnect the Systems

A residential PV array is not a complicated electrical system, but the co-op needs to take care when designing an offering that could potentially end up at many member-consumers' homes. In addition to the hardware being installed, planning needs to include how the systems will be interconnected and monitored, and who will install them.

RESIDENTIAL SOLAR COMPONENTS

The two most important components of the system are the panels and the inverters.

Residential solar systems typically consist of four key components:

1. Solar panels
2. Inverters
3. Racking/mounting systems
4. Performance monitoring systems

Because failures are rare and performance is consistent, the panels can be regarded as a commodity.

Panels: The solar panels generate DC electricity, which the inverter then converts to AC. Across the residential market, panel sizes are remarkably similar; roughly 65 inches by 39 inches, plus or minus a couple of inches. Most standard-size panels contain 60 cells and generate roughly 280 watts per panel. Although some differentiation is beginning to appear, providing somewhat higher efficiencies and larger panels, the more efficient panels, which convert more of the available sunlight to power, are priced higher, somewhat leveling the cost per kW relative to their competitors.

Even with some differences in efficiency, the cost per kW is relatively consistent across the industry. The panels themselves are relatively consistent in quality and generally covered by 20- to 25-year warranties. Because failures are rare and performance is consistent, the panels can be regarded as a commodity. As noted above, panels with higher efficiency typically have higher prices. Because the net cost per watt remains similar across most brands, price per watt is usually a controlling factor in selection. An exception is when higher-efficiency panels might offer an advantage for applications in which space is limited.

Because a microinverter failure affects only one panel in the system, the effect of shading or a panel malfunction is limited only to that panel.

A final consideration for value shoppers is that the consistent quality across the industry suggests that unbranded panels are likely to be of similar quality but cost less than the branded types, making them an acceptable choice.

Inverters: There are essentially two basic technologies for DC-to-AC inverters:

- *String Inverters:* String inverters are typically slightly more efficient and common for larger systems. They are called "string inverters" because they control a string of panels linked together. For instance, a 20-panel system might have 4 strings of 5 panels, with an individual string inverter connected to each of the 5-panel strings. A string inverter is limited by the panel with the lowest output (i.e., a shaded panel) and should be avoided when shading or roof orientation will affect a portion of a string.
- *Microinverters:* These units are becoming a popular choice for rooftop systems as their costs decline and because each microinverter affects only one panel. When a string inverter fails or some panels are shaded, the entire string of panels is affected. Conversely, because a microinverter failure affects only one panel in the system, the effect of shading or a panel malfunction is limited only to that panel. As a result, it is a better fit for systems subject to shading or with more than one orientation due to roof configuration. It can be argued that microinverter systems are inherently more reliable than traditional inverters because the distributed nature of a microinverter system ensures that there will be no single point of system failure in the PV system. Additionally, some microinverters can also offer reactive power control.

Power Optimizers: To increase efficiency, power optimizers also might be used with string inverters to increase energy output from PV systems. Power optimizers are DC-DC converters connected to each PV module. Their main role is to condition the DC electricity before sending it to a central inverter for the string. As with microinverters, the main advantages of power optimizers are mitigation of partial panel-shading impacts and panel-level monitoring. Costs for microinverter or optimizer installations are becoming roughly similar.

"Smart" Inverters: This technology also is beginning to evolve. Smart inverters are capable of providing communications, remote monitoring, troubleshooting,

energy management, grid interaction, and more. The cooperative should track this technology during program development so it can incorporate these new advances if the opportunity arises.

Racking Systems: The racking system is the structural infrastructure that supports the panels on the roof or ground mount. The racking allows installation to be rooftop or ground mounted, depending on individual circumstances and the co-op. There are many different types, but all have the primary purpose of supporting the solar panels and attaching the system to the roof- or ground-mount system. The racking system is usually bolted or screwed onto the roof; on certain roofs, however, it may function as a ballasted system, with weights holding the system in place. In such instances, local seismic codes may require the system to be anchored in some way to avoid movement off the roof during an earthquake.

Performance Monitoring System: The performance monitoring system is a software system that reads, monitors, displays, and records the real-time production of the system. The system can help its owner to spot system performance problems. It can also allow the cooperative to monitor the system remotely and provide historical and maintenance data.

GROUND-MOUNTED SYSTEMS

Cooperatives are in a unique position to offer ground-mounted residential PV systems in addition to rooftop PV because their members are more likely to own land. Ground-mounted systems are electrically similar to rooftop systems but have both advantages and disadvantages. One of the primary advantages is that the array can be properly oriented in a shade-free area, which may not be possible with a roof-mounted system. In addition, size is not constrained by the available south-facing roof area. The ground-mount system also avoids issues around roof penetrations and structural concerns, which may be especially relevant for older buildings.

In general, however, ground-mount systems will cost more because of the need for an elevated structure and foundations, and because of the longer wiring runs needed to connect to the inverter or load panel at the house. The National Electric Code also has more stringent rapid-disconnect requirements for roof-mounted than ground-mount systems. Single or dual axis ground-mounted structures may offer the promise of additional energy, but the value of this energy must be balanced with the added installation costs and maintenance required by the tracking systems.

STANDARD INSTALLATION

A typical 5,000-watt rooftop system for a home might include the following:

- Solar panels – 20 panels at 250 watts each
- Microinverters – 20 microinverters, each with a 250-watt capacity
- Cables to interconnect the modules
- Complete racking system with rails and clamps
- A mounting kit, consisting of various types of hardware (clamps, bolts, etc.)
- System monitoring, if purchased ($500–$1,000)
- Miscellaneous: Wire, conduit, fittings, breakers, AC/DC disconnects, junction boxes, and sub-panels

Note: Although string inverters are currently slightly less expensive than microinverters, inverter replacement for a 5-kW system will likely be needed within 10 to 15 years at a cost of $2,000 to $3,000. Microinverters are typically projected to have a 20- to 25-year life.

Engineering services will be required for the following:

- The design and installation of the solar system
  - Evaluation and selection of system components and vendors
  - Design of the integrated system, including coordination of the racking system
  - Ensuring that the system meets state and local building, electrical, and safety codes
  - Metering design and selection
  - Sizing of the system
  - Analysis of rooftop layout
  - Design for home electrical connections
  - Roof structural check, where applicable (system weight can be 2.5 to 3 psf)
  - Calculation of system output
- Interconnection of the solar system to the distribution system
  - See **Section 6** and the **DG Toolkit** for more information on interconnection processes.
- Distribution system studies that identify capacities, capabilities, and possible upgrades for:
  - Feeder line
  - Local transformers
  - Substation capacities
- Relay protection schemes
- Power flow studies
- Transmission system interconnection requirements, if applicable
- Evaluation and selection of monitoring system
- Preparation of technical specifications and bid requests

The solar industry's components have become somewhat commoditized due to mass production and a market very competitive in quality and features. Consequently, a cooperative may be able to obtain better pricing and quality by using competitive bidding for the solar components, with at least three vendors solicited for each major component category — the solar panels, the inverters, and the racking system. China is a major world supplier of solar components, so if the cooperative is subject to any "Buy American" requirement (or has adopted its own policy to "Buy American"), it may wish to consider this fact in constructing its competitive procurement process.

Cost reduction tips:

- Outsource much of the engineering (obtaining building permits can be a lengthy process — consider leaving it to a specialist) and seek a fixed fee per installation. Outsourcing can avoid over- and understaffing.
- Use integrated racking to reduce the component count and installation time/cost.
- Avoid customization of installations. The solar component package should be standardized to the extent possible by using the same components, thus minimizing inventory, handling, and material shortages, and maximizing purchasing efficiencies.

GENERAL INFORMATION AND RECOMMENDATIONS

As it reviews its program design, a cooperative should consider the following issues. No one answer may be right for every cooperative, but considering the issues before making fundamental investment and program design decisions may be more cost-effective for the cooperative and its members in the long run.

Considering the issues before making fundamental investment and program design decisions may be more cost-effective for the cooperative and its members in the long run.

Should the cooperative minimize variations in the system design? Variation can provide more flexibility but can also introduce additional cost and complexity. A standardized system may reduce field errors, such as missing parts and assembly problems. A standardized design approach (e.g., limiting the available system sizes to 4-, 6-, and 8-kW packages) can reduce delivery errors and increase the efficiency of deliveries to the site.

Microinverters should be designed to operate at full power during high temperatures, recognizing that roof temperatures can significantly exceed ambient air temperatures. The microinverter housing should be designed for outdoor installation and comply with the Net Energy Metering Aggregation (NEMA) Type 6 environmental enclosure rating standard.

An advantage of microinverters is that the low-voltage DC wires connecting the PV module directly to the co-located microinverter can reduce the risk of exposing personnel to dangerously high DC voltage.

The system should be protected with lightning and electrical surge suppression devices. In addition to having some level of surge suppression, it is also prudent to carry insurance that protects against lightning and electrical surges.

The cooperative should investigate recent advances, such as integrated racking designed for a specific component package. These systems can reduce the parts count and number of missing pieces, improve installation efficiency, and reduce labor costs. Racking should be constructed of non-corroding materials because it will be exposed to the elements for decades.

The installation crew will be perceived as representing the cooperative and must demonstrate respect for member-consumers and their property.

Be aware that each rooftop solar system will have a unique design. Co-ops will need to address roof slope, orientation, shading, roof penetrations, and other equipment on the roof, as well as required setbacks from the roof edge and possible seismic requirements to secure panels in the event of an earthquake. Installers often outsource this design work to specialists who can do much of it at a desk-top level via software that uses satellite photos.

Other factors, such as roof slope or surfacing, will also affect installation costs. For instance, a slate or tile roof may add thousands of dollars compared to a typical asphalt roof. To a large extent, panels are very similar, and thus a commodity, so shop for pricing. The layout of the panels, called "tiling," can be optimized and laid out in either a "portrait" or "landscape" orientation. Note that panel efficiencies can range from 14% to 22%, with prices reflecting efficiency value. The main benefits of high-efficiency panels are the reduced installation cost due to fewer panels needed and the increased generation capability of small roofs.

For commercial systems, a single inverter is large, heavy, and unwieldy. It also represents a single point of failure that can shut down the entire system. Consider multiple smaller inverters. The trend is to use smaller inverters, which are easier and quicker to replace.

CONTRACTORS AND INSTALLATION CREWS

Installation crews, whether comprising cooperative or contractor staff, must be thoroughly trained, not just on the system installation, but also in safety practices and customer relations. The installation crew will be perceived as representing the cooperative and must demonstrate respect for member-consumers and their property. Maintaining good will with member-consumers is paramount.

The cooperative will need to determine whether to perform installation with cooperative employees, third-party contractors, or a combination of the two. If the co-op is using installation contractors, the bidding process should include at least three contractors. Consider quality, experience, safety record, and reputation in the selection; price, although important, should not be the final determining factor.

The cooperative should develop a formal procedures manual to document the process step by step, beginning with the homeowner signing a contract for the solar system and continuing through its commissioning. The co-op also should establish formal procedures for verification of permits and commissioning and, following commissioning, maintain an ongoing file for the solar system, documenting any maintenance performed, member-consumer contacts, or other issues.

Relevant employees and any contractors should be trained on and familiar with the procedures manual. A cooperative employee should be assigned to oversee the overall process and manage the installation process and contractors.

This employee may also be assigned as the initial contact with the homeowners to maintain a cooperative "chain of continuity" for the member-consumer throughout the process, from start to system commissioning.

The time from signing a contract with the member-consumer to commissioning the system is likely to be 30 days or more. Although the actual installation of a typical 5-kW system may only take one day with a sizable crew, the design, layout, permitting, and other processes take considerable time, so the member-consumer should be advised about the estimated schedule early in the process.

Commissioning the system should include a detailed check of all components and operations by a qualified professional. Each component should be tested, including confirmation of communications with the central monitoring system, before leaving the site. The commissioning supervisor should fill out and sign a formal checkout form and leave a copy with the homeowner.

Finally, all technical records for the solar system need to be maintained in a database readily accessible to subsequent operations and maintenance personnel and that meets any applicable legal requirements.

Monitor and Maintain the System

Performance Monitoring System: The performance monitoring system is a software and communications system that reads, records, and displays the real-time and historical production of the system. The data can help the system owner to spot system performance problems and can also allow the user and cooperative to remotely monitor the system and even potentially control certain of its aspects to provide additional value to the grid.

Typical commercial monitoring systems provide near-real-time data to customers via web-based or smart phone apps.

Typical commercial monitoring systems provide near-real-time data to customers via web-based or smart phone apps. This functionality usually requires either a cell phone modem or a continuous Internet connection, which may be more difficult to obtain in sparsely populated rural areas.

All monitoring systems provide a record of full system output, whereas some systems provide module-level details through microinverters or optimizers. This level of detail is especially helpful in identifying problems with the system. The monitoring system should also pass along inverter fault codes in case homeowners do not check the flashing lights on their inverter(s). If the co-op is managing the monitoring system, these data can be combined with real-time or historical billing data to provide additional information on member-consumer usage.

Residential and small commercial systems generally need very little maintenance.

SYSTEM MAINTENANCE

Residential and small commercial systems generally need very little maintenance. The modules are self-cleaning in most areas of the country. Physical maintenance is limited to an annual inspection: checking the tightness of electrical connections or looking for discolored wires/terminals that might indicate loose connections. More sophisticated maintenance could involve photographing the array and/or inverter with an infrared camera to look for faulty equipment.

If a string inverter fails, the array and grid can be isolated easily and the equipment swapped out for a working unit. Internal repair of these devices generally requires a clean environment, a trained technician, and specialized tools. The failure of string inverters or module optimizers will require access to the array, usually meaning access to the roof. These units must be replaced on site and then repaired/refurbished in a shop environment.

Software/firmware upgrades can be done either online or via a direct communication link through the system communication portal (typically USB). The former can be performed automatically or could be initiated by the user (similar to firmware upgrades to a modem/router); the latter usually requires a site visit by a qualified technician.

The cooperative should keep records of all maintenance events.

The cooperative should keep records of all maintenance events, and the technician should leave a paper copy of a maintenance/repair log on site with the system. A more comprehensive maintenance system would also contain electronic records of all maintenance and repairs.

SOFTWARE AND BILLING

Software support for a utility solar program can reduce costs, increase subscribership and retention, and reduce mistakes. Software integration has an important role as the bridge between the member-consumer and the array, providing the subscriber with real-time solar production and/or potential cost savings data. However, software products can be expensive, and few options are available. The cooperative should carefully assess the costs and benefits as part of the IT plan.

The two primary areas where software can support a program are the following:

1. Customer information system (CIS)/billing modification requirements and options
2. Member-consumer management tools, "self-serve" automation, and data collection service

The following are features to consider for solar software:

- Integrate a production reporting and billing software program into an existing billing system to track and apply credits directly to consumer bills
- Use a single program management dashboard, allowing the billing department to visualize, report, and manage all key metrics and actions
- Function as a single point of easy access for all internal inquiries and processes involving the solar program, allowing easy access to data needed to handle any disputes
- Enable the utility to remain in control of billing integration at all times
- Maintain adequate liability insurance to cover any security breaches
- Make information available to member-consumers via a mobile app for their tablet or phone
- Organize and maintain necessary records and contracts

This package would enable the member-consumer to do the following:

- Explore the value of the program, sign up for the solar program online, utilize on-bill financing, understand the costs of installations, and track their installations
- Track their account data to answer questions, identify problems, or change program services
- Check production from their panels

This package would enable utilities to do the following:

- Accurately automate the information on the member-consumer's account and bill
- Double-check the information for accuracy
- Access an account for transfers, if necessary
- Ensure that all contracts and other documentation have been executed
- Monitor solar production
- Access any O&M issues

SOFTWARE INTEROPERABILITY

The solar program's software should be capable of being integrated with incumbent software. This can be done in the planning process by documenting the following areas:

1. Software and hardware requirements
2. Software customization requirements
3. Process semantics (data inputs and outputs)
4. Testing requirements

Ideally, regarding interoperability, the software package should have the following capabilities:

- Ready to implement
- Can be proof-tested in multiple existing installations
- Allows product development that does not require extensive customization by the end user — thus not requiring significant technical or IT staff or outside consulting support
- Can be used either with or without messaging infrastructure (e.g., "middleware")
- Is extensible without compromising the basic interoperability of the interface
- Is scalable to allow use for any size utility or information demand
- Is capable of being supported by a wide range of vendors — especially billing and meter data management vendors
- Includes an existing, modestly priced commercial testing process to help utilities and vendors ensure interoperability
- Has a large number of individuals trained in the use of the specification

CUSTOMER ENGAGEMENT PLATFORM/ONLINE WEB PORTAL

Customer engagement platforms benefit both member-consumers and the utility by providing accurate real-time information about the array and ownership portions of each member.

Suggested capabilities include the following:

- Function as a consumer management system
- Automate and track member-consumer interest
- Streamline and simplify sign-ups with e-commerce
- Provide data to prospective member-consumers
- Generate proposals
- Create marketing reports
- Utilize a single platform with multiple credential levels: an administrative platform and a reporting dashboard
- Provide system performance data to member-consumers in near-real time

Cooperatives should consider what obligations they may have regarding securing member data collected through the residential solar program engagement/online portals. Examples would be state data privacy laws and the Payment Card Industry Data Security Standard (PCI DSS or PCI).

For more information on PCI DSS, please visit the PCI Security Standards Council website at **https://www.pcicomplianceguide.org**.

LEGAL REQUIREMENTS, BILLING, AND RECORD KEEPING

Depending on how the program is set up so that member-consumers and the utility share ownership and benefits, there may be legal requirements. The cooperative should work with legal counsel to determine how member-consumers will receive credit. Some legal considerations include the following:

- Identify the needs for, and value of, automation for billing and record keeping — specifically, review Sarbanes-Oxley requirements for billing and data retention and corrections
- Outline the record-keeping requirements, particularly as they relate to Renewable Energy Certificate (REC) tracking
- Determine the value of RECs and whether they are assigned to participants, retired on participants' behalf, or retained by the utility
- Determine the value of additional non-electricity production provisions, such as ancillary services

Additionally, the cooperative needs to consider and pay attention to collecting, managing, and securing these types of data:

1. Personally identifiable information (PII), such as name, date of birth, social security number, medical information, etc.
2. PCI compliance, such as payment and billing information, credit card data, banking account data, etc.
3. Member-consumer usage data
4. Sensitive business data

This list is illustrative, not exhaustive. Cooperatives should seek legal counsel on their obligations regarding collecting, managing, and securing data.

CYBER SECURITY

Cooperatives should work with legal counsel to review applicable laws and regulations related to cyber security, especially regarding member-consumer data and privacy, and using vendors. The responsibility for securing confidential consumer and business information rests with many people, not just the IT staff.

If a third party is going to be used for any aspect of the project, it is imperative that the vendors be made responsible for their part of the cyber risk management process. The U.S. Department of Energy provides sample procurement language and guidance to communicate cyber security expectations clearly. For example, when purchasing software, the recommended language is as follows:

> "The Supplier shall remove all software components that are not required for the operation and/or maintenance of the procured product. If removal is not technically feasible, then the Supplier shall disable software not required for the operation and/or maintenance of the product. This removal shall not impede the primary function of the procured product. If software that is not required cannot be removed or disabled, the Supplier shall document a specific explanation and provide risk mitigating recommendations and/or specific technical justification. The Supplier shall provide documentation on what is removed and/or disabled."[2]

It is important to set clear and appropriate expectations with vendors concerning cyber security obligations.

[1] Cybersecurity Procurement Language for Energy Delivery Systems (Rep.). (2014, April). Retrieved https://energy.gov/sites/prod/files/2014/04/f15/CybersecProcurementLanguage-EnergyDeliverySystems_040714_fin.pdf.

Monitor Maintenance and Member Service

Although maintenance of solar systems should be minimal, some typical maintenance problems include replacement of string inverters at the system's mid-life, squirrels gnawing on wiring, pigeon nests, and growing trees that can cause shading. This section provides suggestions and considerations for maintenance programs, but other maintenance strategies may be more suitable for your co-op.

Because panel malfunctions are rare, more likely issues would involve wiring and the inverter.

Monitoring systems can perform panel-by-panel monitoring to identify panel malfunctions. Because panel malfunctions are rare, more likely issues would involve wiring and the inverter. Note that if the member-consumer has a monitoring system, there is a potential for false alarms due to communications glitches, short power outages, Internet interruptions, and other factors — any of which can trigger a monitoring notification even if the system is operating properly. In some systems, the monitoring system will self-correct in a day or so. Also, some newer monitoring technology now available can operate through cell phone networks, thus eliminating the need for Internet access, although there may be an additional cost for the cell service.

It is important to discuss panel cleaning with the member-consumer. In rainy areas, panels are normally kept clean due to regular rainfall and will not require cleaning. In dry, dusty areas, panels may need to be cleaned to maintain performance. Cleaning costs for rooftop solar using a contractor may be $100 to $200; once or twice a year may be sufficient in areas that go without rain for long periods. The residual minerals in the water used to clean panels can build up and diminish output, so cleaning should involve a squeegee and a cleaning additive in the wash solution. A minimum of a 10% tilt of the panels is recommended to ensure drainage and avoid standing water on the panel surface.

Recognize that hot temperatures reduce PV output. This phenomenon is somewhat counter-intuitive, so explaining it in advance can avoid member-consumer calls when output diminishes on hot sunny days. If they have concerns about diminished output, suggest that they compare corresponding months from previous years as a basis of evaluation. Unless the cooperative is providing ongoing monitoring to identify problems quickly, member-consumers should be reminded to check the inverter periodically to make sure it is working properly.

Also be aware that PV efficiency can be expected to decline roughly 0.5% per year as equipment ages. For this reason, the manufacturer's warranty may guarantee only 80% of output at 20 years of age.

Overall, it may be advisable for the cooperative to provide maintenance service. It can provide assurance to the member-consumer that a reliable maintenance service will be available in the long term and can provide a value that differentiates the cooperative from its competitors.

WARRANTY CAUTION

Solar panel warranties typically cover 20 to 25 years, and inverter warranties typically cover 10 to 12 years for string inverters and 20+ years for microinverters. Be aware that the companies behind the warranties are not immune to failure; the cooperative may have to address warranty issues in the absence of the manufacturer. Fortunately, panel failures are rare and inverter failures fairly predictable, so inverter replacement costs can be incorporated into the economic pro forma — for instance, planning for scheduled string inverter replacement somewhere around the 10-year mark.

HOMEOWNER CRITERIA

Criteria for selection of member-consumer subscribers for a rooftop solar program must be established and communicated early to avoid unrealistic expectations. Some possible criteria to consider might be the following:

- Homes with shaded roofs or poor orientation may well lead to poor performance of the system, resulting in homeowners' dissatisfaction.
- Homeowner creditworthiness — Solar programs often require the contract to be with the homeowner of record, along with verification of credit and confirmation that financing and taxes are current.
- If roof replacement will occur within the next 4 to 5 years, it may be preferable for the homeowner to replace it before installing a rooftop solar system, or defer installation until after replacement.
- Homes with tile or metal roofs may present some installation challenges — evaluate them before committing.
- It may be helpful to prioritize homes in areas where solar resources will provide maximum benefits to the local electric grid.
- The co-op should be careful before installing solar at homes with the following:
  - Housing code violations
  - Outdated or unsafe electric service entrances
  - Electric service entrances that do not allow proper interconnection
  - Structurally unsound or unsafe roof conditions
  - No safe access for installation and maintenance of a solar power system
  - No way to accommodate the installation of a solar power system with a capacity of at least 3 KW (small systems lack economy of scale and have a higher cost per unit)

MEMBER-CONSUMER RESPONSIBILITIES

Any contract for rooftop- or ground-mounted solar should define the cooperative's expectations of the member-consumer's responsibilities. For instance, the following questions should be addressed:

- Will it be the member-consumer's responsibility to clean the panels?
- Will it be the member-consumer's responsibility to keep nearby trees trimmed to avoid shading?
- If the system is damaged by the member-consumer, who will be responsible for the cost? Will repairs be made only by the cooperative, or is the member-consumer allowed to arrange for other service?
- Will the member-consumer be required to maintain Internet access for monitoring purposes?
- What items will be covered by the warranty, e.g., inverter replacement? In 10 or 15 years, who will be responsible for inverter replacement?

- System performance monitoring:
  - Will the member-consumer be given access to the system performance monitoring information?
  - Will the member-consumer accept cooperative monitoring (a privacy issue)?
- Will the member-consumer be able to monitor system performance online?
- What monitoring service will be provided to the member-consumer?
- Who should the member-consumer call regarding system problems or issues?

8

Case Studies for Residential Solar Programs

This section provides case studies intended only as examples to illustrate how several utilities are offering solar programs to their member-consumers above and beyond solar incentives. It explores both cooperative and non-cooperative programs to provide a broader picture of what is possible. Each electric cooperative should use its independent judgment and discretion to make its own business decisions.

Programs highlighted in this section:

1. **Pedernales Electric Cooperative**
2. **CPS Energy of San Antonio, TX**
3. **Arizona Public Service**
4. **Delta-Montrose Electric Association**
5. **Anza Electric Cooperative**
6. **Wright-Hennepin Cooperative Electric Association**

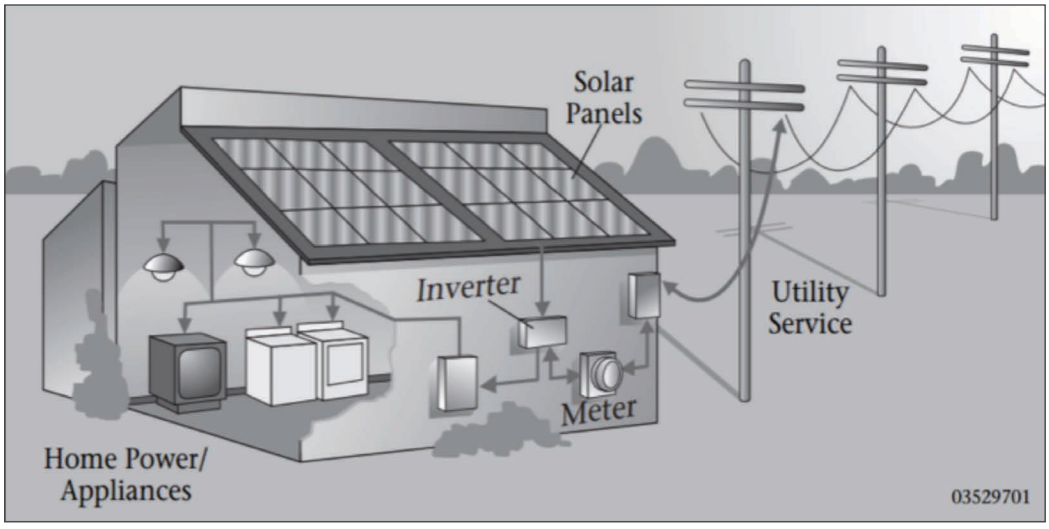


Figure 5: Residential Grid-Connected PV System. *Source: DOE — A Consumer's Guide: Get Your Power from the Sun.*

Case Study #1
Pedernales Electric Cooperative

Located in central Texas, Pedernales Electric Cooperative (PEC) delivers electricity to more than 270,000 active accounts throughout 8,100 square miles — an area larger than the state of Massachusetts. PEC also has the most meters of any electric cooperative in the United States.

PEC has been working with member-consumers on solar energy for several years. According to Blake Beavers, PEC's Distributive and Renewable Energy Manager, PEC began working on its solar program because that is what its membership wanted. PEC is located in a good solar resource area and, with two nearby municipal utilities also offering solar programs, interest in solar generation is high in the region.

With a number of rooftop solar installations already in place, PEC strives to offer different options for its member-consumers. For example, PEC is evaluating a mix of community solar options for those who may not be able to implement rooftop solar due to issues such as shading or roof orientation. Other options, such as providing a Renewable Rider option, are also available. For the actual purchase and installation of the solar system, PEC acts in more of an advisory role, striving to educate its membership so they know what they are getting into.

As a next step in its solar evolution, PEC recently established a contract with RES Americas for up to 15 MW of solar arrays to be evaluated or installed over the next year. Their locations and sizing currently are being finalized.

Beavers noted that the price point of solar in PEC's area is competitive with market prices. Although there are no state incentives, solar installation costs are lower than the national average, ranging from $2.85 to $3.25/watt. PEC is encouraging more of its member-consumers to go solar, recently kicking off an on-bill financing program for member-consumer-owned solar installations and battery storage.

Beavers also pointed out that most of the interconnection process can be handled through the PEC website. To interconnect a solar system, the member-consumer can simply go online, fill out the application, and upload all supporting documents. All documents can be found online at the same spot, making it easier for member-consumers to go through the process. The website also offers a checklist form that the member-consumer and PEC both sign. This one-page form contains the member-consumer's information and check-offs for the documentation required to verify new installations.

PEC's goal is to automate the interconnection process on the Internet as much as possible. Consumers can even track their net consumption using PEC's new online account management portal. The website also provides a video of a solar installation inspection by PEC personnel.

To date, all rooftop solar systems have been installed by independent third-party installers and are net metered. PEC has a monthly true-up and will purchase any net generation above the member-consumer's monthly consumption.

The overall penetration of solar in the system has not been great enough to cause negative system impacts. In the future, engineering will look at potential issues; Beavers noted that there may also be some benefits, such as reduced losses.

(continued)

Pedernales Electric Cooperative (continued)

When asked about "lessons learned," Beavers emphasized that it is important to put the correct policies in place, look to the future, be open minded, have vision, and evolve to meet the changes. He also noted that PEC tries to be involved with the member-consumers as much as possible. PEC offers annual solar tours to allow member-consumers and vendors to visit some the solar systems. The solar tour event typically has 400 member-consumers in attendance. Finally, co-ops need to make sure staff are trained and understand the policies and processes offered by the utility.

Case Study #2
CPS Energy

CPS Energy (CPS Energy) of San Antonio, Texas is the nation's largest gas and electric combined municipal utility. CPS ENERGY offers three solar programs to member-consumers: rebates, community solar, and rooftop hosting. These programs provide member-consumers with a broad range of options.

SOLAR REBATES

For rooftop solar installations by member-consumers, CPS Energy offers rebates in addition to the federal tax incentives. It allocated an additional $30M in rebates in 2016, with the money allocated on a first come, first served basis. Rebate amounts declined slightly for every $10M. Residential rebates were exhausted by the end of 2016.

Member-consumers seeking to install a home solar system begin by obtaining bids from solar installers. Once selected, the installer submits a solar program registration form, including pre-construction documents. This form must be submitted in advance of installing a solar system. CPS Energy then uses the information in the form to establish an account for accepting a subsequent application.

CPS Energy provides considerable guidance to homeowners, including a Distributed Generation Manual (downloadable from its website) specifying applicable procedures, standards, and requirements for interconnection to its system. The utility also provides links to standards established by the California Energy Commission. These links list approved solar panels and inverters acceptable to CPS Energy. The website also provides a list of registered solar contractors. To be on the approved contractor list, solar contractors must meet certain criteria.

CPS Energy also requires pre-construction documentation, including:

1. A one-line electrical diagram for the proposed system, including but not limited to meters, disconnects, inverters, and member-consumer and utility interconnections

(continued)

CPS Energy (continued)

2. Proposed site layout or plan of the facility and equipment
3. Manufacturer's sheets for the proposed solar panels and inverters
4. Application for installation/interconnection of distributed energy resources
5. Photos of member-consumer's current equipment
6. Fully executed contract between the member-consumer and contractor, specifying that the former is the owner of the system

Following installation and commissioning, which must also be acceptable to the local AHJ, the member-consumer may then submit an application for the rebates offered by CPS Energy. To obtain the rebate incentive, member-consumers must assign the rights to the RECs generated by the member-consumer's solar PV system to CPS Energy, which will record and track the amount of renewable energy generated by the solar PV system. Other criteria for the rebate include:

- The member-consumer is required to review and sign a solar disclosure form, which is intended to educate member-consumers about their rights when purchasing a solar system, typical market pricing for such systems, and expected output based on system sizing.
- A maximum per watt (DC) price is required for the residential PV system, although some exceptions are allowed.
- The system must be installed by a CPS Energy-registered solar contractor.
- Fees and caps include the following:
  - A non-refundable administration fee is required for each rebate application.
  - An additional commissioning charge is deducted from the final project rebate amount to defray a portion of CPS Energy's metering, commissioning, and administrative costs for solar rebate member-consumer installations.
  - The rebate amount is capped per residential account per year. Rebates are also capped at 50% of the installer's invoice cost.
- CPS Energy installs and owns the billing/revenue and PV meters.
- Solar PV systems may not be energized until the commissioning test, and systems may stay energized only if they pass the commissioning test.

THE SOLARHOST PROGRAM

This option is essentially a roof-leasing program. Under this program, member-consumers may apply to install a solar system on their roof. Each roof application is evaluated by PowerFin Partners, CPS Energy's third-party contractor in the transaction. PowerFin owns the solar systems, and CPS Energy buys 100% of the power generated under a 20-year power purchase agreement (PPA). PowerFin shares a portion of the PPA revenue stream with the homeowner as compensation for the roof space.

The initial application review is done using satellite imagery to assess roof orientation and shading. If the initial desktop review is acceptable, a PowerFin representative then performs an on-site evaluation. If a roof qualifies, PowerFin installs a solar system at no charge. An average home is expected to receive a system of about 4 kW. For the use of the roof, member-consumers will receive a credit on their bills for each kWh produced by the solar panels.

(continued)

CPS Energy (continued)

The program enables member-consumers to host a rooftop system without the cost of installation and maintenance. The member-consumer then receives "rent" for the use of the rooftop. If a member-consumer sells the home, the new homeowner will be enrolled as a solar host and receive the host credit on the monthly CPS Energy bill for the remainder of the program.

THE ROOFLESS SOLAR PROGRAM

This is a community solar program operated by the Clean Energy Collective (CEC). Under this program, CEC builds and maintains a RooflessSolar array that delivers power to CPS Energy. As in most community solar projects, member-consumers sign up and purchase panels in the solar array.

Under the program, the member-consumer selects the quantity of panels to be purchased within the solar array. Then, as power is produced by the array, it is delivered to the grid for CPS Energy. Participating member-consumers will then receive credit on their electric bills for the power produced by their panels within the solar array. CEC manages the community project and handles all operations and maintenance of the RooflessSolar array.

This program works well for member-consumers who may have homes not well suited for the installation of traditional rooftop solar due to shading limitations, shared rooftop ownership, structural issues, accessibility for maintenance, homeowner association (HOA) limitations, etc. Because the community project is located elsewhere, any electric member-consumers — even renters — can participate regardless of these limitations; also, the roofless solar array is more easily sited and oriented to ensure optimal solar production.

CEC's website, **http://www.rooflesssolar.com**, provides information on financing options and a savings calculator/proposal generator for member-consumers. In most markets, the federal tax credit for the solar array is integrated into the financing and development of the project, so it is reflected in a discount in the purchase price to member-consumers, thus eliminating their need to file as individuals. However, in select markets (including that of CPS Energy), member-consumers may need to file to obtain federal tax credits. CEC generally estimates the payback period for participating member-consumers as ranging from as few as 5 years to 15 years. Because CEC works with multiple projects and utilities, variations in payback will be affected by utility bill credit rates, available rebates, financing rates, and system development.

For More Information:

Detailed information and forms for each of these programs can be found on the CPS Energy website, **cpsenergy.com**.

Case Study #3
Arizona Public Service (APS)

Arizona Public Service (APS) has a solar power portfolio of more than 1,000 MW, split almost evenly between rooftop systems and grid-scale projects, with 551 MW coming from rooftop systems and 499 MW from grid-scale projects. Of the rooftop solar, APS owns 10 MW.

Most of the rooftop solar comes from systems owned by homeowners or leasing companies, with the economics driven by offsetting power purchases and net billing or net metering. For homeowners who have installed or leased a residential solar system, APS offers the following renewable plan options:

1. epr-2 net billing, which provides a per-kWh bill credit for any excess kWhs the system produces
2. epr-6 net metering, which uses bi-directional meters to record the energy delivered to the member-consumer as well as that sent from the member-consumer to APS; if the system produces more electricity than is used, the monthly bill will show a kWh credit

These plans provide kWh credits based on time of use (on-peak/off-peak) and seasons (summer/winter).

For participating member-consumers, the generating units must be no more than 125% of the residence's total connected load.

APS also currently has two residential solar research programs. In its **APS Solar Partner** program, APS has partnered with the Electric Power Research Institute (EPRI). It will work with local installers on selected electric distribution system feeders to install top-tier solar panels and advanced inverters. The program is expected to result in specific areas of high penetration of solar for the present and help APS learn how to better integrate solar and other renewable technologies in the future. A goal of part of the study is to compare late afternoon solar production against peak usage periods.

Some specifics about the Partner program are the following:

- APS-owned
- Target size: about 1,600 homes
- Full utility control
- Approximately 10 MW rooftop solar systems
- 4 MWh batteries
- Advanced inverter study with various use cases
- Panels on the utility side of the meter

The APS Solar Partner program is offered on a first-come, first-served basis to qualified member-consumers; the targeted project size has been reached. This program is free to member-consumers, and provides $360/year of annual savings on APS electricity costs. No commitment is required and the system is easily transferred to a new homeowner.

Participation in this program is for qualified homes with a westerly facing roof in peak usage areas. A limited area of south-facing roofs will qualify in targeted areas. Qualification requirements are as follows:

- Single-family detached home
- The pitch of the roof should be angled toward the west, capturing direct afternoon sunlight (some southwest- and south-facing roofs may qualify)
- The roof must be free of shade

(continued)

Arizona Public Service (APS) (continued)

- Acceptable roof types for solar panel installation are as follows:
  - Shingle
  - Flat concrete tile
  - Metal-architectural standing seam
- Able to accommodate a minimum of 16 solar panels (each panel is approximately 3.26 ft x 5.38 ft)

APS will own the system and cover the cost of installation and all maintenance.

In addition, APS has also initiated the **APS Solar Innovation Study – 75**. In this study, every home in the research project will be equipped with an array of 6 kW of solar panels. The array is expected to produce approximately 9,900 kWh of energy per year, depending on roof orientation.

Every home in the project will receive an inverter that can be connected to a mobile app to monitor solar production. Selected homes will also receive high-efficiency HVAC upgrades; some others will receive battery storage technology. Those member-consumers not receiving battery storage will instead receive a gateway device to act as a central data hub for the home. This device will collect and send real-time energy data directly to the member-consumer's mobile app while also providing control of the load controllers installed on some appliances. Wi-fi-based thermostats will also allow remote control by using a mobile app. At any time, the homeowner will be able to override the load control or change the appliance priority.

Case Study #4
Delta-Montrose Electric Association

Delta-Montrose Electric Association (DMEA) partnered with the Colorado Energy Office to establish a solar program assisting low-income people in reducing their electric bills. In addition to environmental concerns, many of DMEA's member-consumers value individual ownership, independence, and cost stability. This community solar program enabled the cooperative to respond to strong member-consumer interest, demonstrate its environmental commitment, and explore diversification of its power supply.

DMEA's program consists of two small community solar projects and a small hydro project. The community solar program is for income-qualified participants and was done in partnership with the Colorado Energy Office through a subsidy. The price per watt is just under DMEA's cost, with the Colorado Energy Office funding 50% of the capital cost.

Under this program, participants lease a portion of two 10-kW solar PV arrays. They receive a credit on their bill each month for the electricity that their portion of the array produces. Leases begin at a nominal price. Each $10 block provides participants with 2.67 W of capacity in the community solar array. For subscribers, a retail value credit is debited to cover DMEA's cost. DMEA's community solar array is currently fully subscribed.

Separately, for individual rooftop solar, DMEA allows net metering and is currently studying the potential for greater solar penetration.

Preliminary indications are that the solar generation will offset approximately 30% of the homeowner's peak demand during high solar months and 10%–20% of the demand charge during low solar months.

DMEA's community solar array program provides its member-consumers with a more affordable way to enjoy the benefits of solar-generated electricity, and has been well received by its members.

Case Study #5
Anza Electric Cooperative, Inc.

In 2011, Anza installed a solar farm project that allowed its member-consumers to participate in purchasing a small amount of renewable energy for their own use without the cost of investing in their own system. It was an experiment in "virtual net metering," in which Anza installed and maintained the system on its building and credited the energy back to subscribers' bills on a pro rata basis.

Kevin Short, Anza's general manager, explained some of the factors that went into the cooperative considering the program.

- The California regulatory environment is aggressively encouraging renewables. California utilities must provide 33% of their electricity from renewable energy sources by 2020.
- Anza was one of the first utilities in California to meet its California 5% net metering mandate.
- Economics: The value of the energy and demand, plus state fees and the renewable energy credit, enabled the program to avoid cross-subsidies.

The offer was very popular, and Anza sold out the subscriptions for this 17-kW program within 20 minutes at its annual meeting. Since then, there have been no significant cancellations.

Historically, the biggest objection to renewables has been cost. However, given the experience gained in this initial program, and with the decline in solar costs, the economics have become favorable, and Anza has announced a new solar array and investment in renewable energy.

Anza's analysis, which has been thoroughly checked by the Arizona Electric Power Cooperative (AEPCO) and a cooperative financial institution, indicates that this program should be good for the cooperative over the long haul, especially considering California regulations regarding renewables and greenhouse gas reduction.

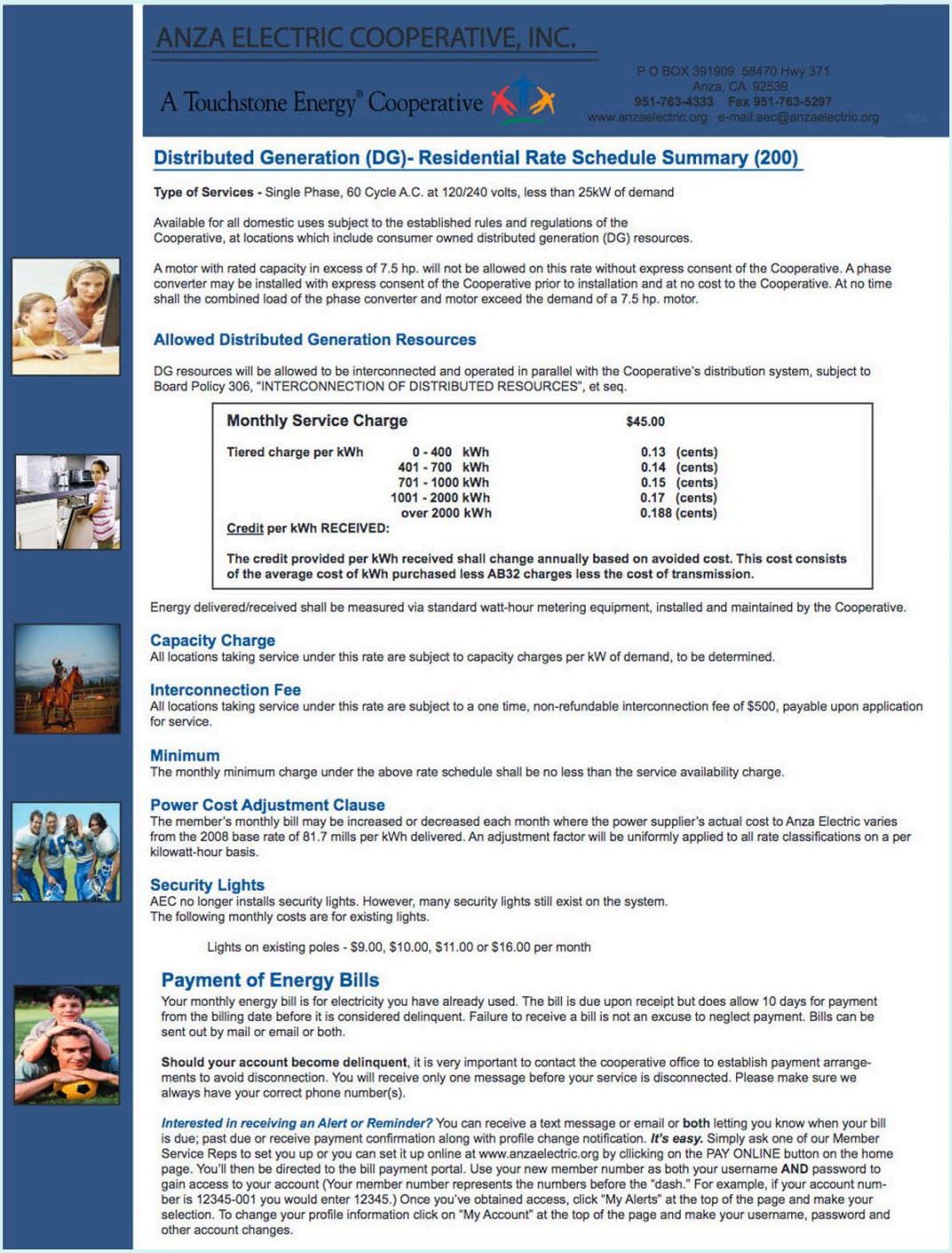
As an all-requirements member of AEPCO, Anza is working cooperatively with its power supplier and a third party, AEPCO's "for-profit" subsidiary, to monetize the tax incentives. Anza's financial analysis of its current project suggests a very good rate of return over the expected life of the system — and the program avoids cross-subsidies. The planned project will also help "forward-proof" some of the cooperative's carbon risk.

Short estimates that the solar array provides a reduction in peaking of 5%–10%. He cautioned that solar takes up a lot of real estate, so land acquisition should be an early consideration for any community solar program. Also, Anza's engineering is watching the project to evaluate its effects on the cooperative's system.

The new solar array is not expected to result in any new cost to members via their rates to pay for the project. Anza is also looking at the potential to modify and expand the program after the installation of its new array. Meanwhile, Anza has established the Distributed Generation Rate for Residential, shown in **Figure 6**.

(continued)

Anza Electric Cooperative, Inc. (continued)



ANZA ELECTRIC COOPERATIVE, INC.

A Touchstone Energy® Cooperative

P O BOX 391909 58470 Hwy 371
Anza, CA 92539
951-763-4333 Fax 951-763-5297
www.anzaelectric.org e-mail:aec@anzaelectric.org

Distributed Generation (DG)- Residential Rate Schedule Summary (200)

Type of Services - Single Phase, 60 Cycle A.C. at 120/240 volts, less than 25kW of demand

Available for all domestic uses subject to the established rules and regulations of the Cooperative, at locations which include consumer owned distributed generation (DG) resources.

A motor with rated capacity in excess of 7.5 hp. will not be allowed on this rate without express consent of the Cooperative. A phase converter may be installed with express consent of the Cooperative prior to installation and at no cost to the Cooperative. At no time shall the combined load of the phase converter and motor exceed the demand of a 7.5 hp. motor.

Allowed Distributed Generation Resources

DG resources will be allowed to be interconnected and operated in parallel with the Cooperative's distribution system, subject to Board Policy 306, "INTERCONNECTION OF DISTRIBUTED RESOURCES", et seq.

Monthly Service Charge		**$45.00**
Tiered charge per kWh	**0 - 400 kWh**	**0.13 (cents)**
	401 - 700 kWh	**0.14 (cents)**
	701 - 1000 kWh	**0.15 (cents)**
	1001 - 2000 kWh	**0.17 (cents)**
	over 2000 kWh	**0.188 (cents)**
Credit per kWh RECEIVED:		

The credit provided per kWh received shall change annually based on avoided cost. This cost consists of the average cost of kWh purchased less AB32 charges less the cost of transmission.

Energy delivered/received shall be measured via standard watt-hour metering equipment, installed and maintained by the Cooperative.

Capacity Charge
All locations taking service under this rate are subject to capacity charges per kW of demand, to be determined.

Interconnection Fee
All locations taking service under this rate are subject to a one time, non-refundable interconnection fee of $500, payable upon application for service.

Minimum
The monthly minimum charge under the above rate schedule shall be no less than the service availability charge.

Power Cost Adjustment Clause
The member's monthly bill may be increased or decreased each month where the power supplier's actual cost to Anza Electric varies from the 2008 base rate of 81.7 mills per kWh delivered. An adjustment factor will be uniformly applied to all rate classifications on a per kilowatt-hour basis.

Security Lights
AEC no longer installs security lights. However, many security lights still exist on the system.
The following monthly costs are for existing lights.

Lights on existing poles - $9.00, $10.00, $11.00 or $16.00 per month

Payment of Energy Bills
Your monthly energy bill is for electricity you have already used. The bill is due upon receipt but does allow 10 days for payment from the billing date before it is considered delinquent. Failure to receive a bill is not an excuse to neglect payment. Bills can be sent out by mail or email or both.

Should your account become delinquent, it is very important to contact the cooperative office to establish payment arrangements to avoid disconnection. You will receive only one message before your service is disconnected. Please make sure we always have your correct phone number(s).

Interested in receiving an Alert or Reminder? You can receive a text message or email or **both** letting you know when your bill is due; past due or receive payment confirmation along with profile change notification. ***It's easy.*** Simply ask one of our Member Service Reps to set you up or you can set it up online at www.anzaelectric.org by cllicking on the PAY ONLINE button on the home page. You'll then be directed to the bill payment portal. Use your new member number as both your username **AND** password to gain access to your account (Your member number represents the numbers before the "dash." For example, if your account number is 12345-001 you would enter 12345.) Once you've obtained access, click "My Alerts" at the top of the page and make your selection. To change your profile information click on "My Account" at the top of the page and make your username, password and other account changes.

Figure 6: Anza Distributed Generation Residential Rate Schedule

Case Study #6
Wright-Hennepin Cooperative Electric Association (WHCEA)

Wright-Hennepin Cooperative Electric Association's (WHCEA's) solar program has evolved dramatically from its beginnings in 2007 with the implementation of Minnesota's renewable energy regulations, which mandated a certain percentage of renewable energy, including solar. WHCEA's member-consumers had a strong interest in renewables; in response, WHCEA installed a 2-kW system and added some battery storage to expand its learning experience.

Because WHCEA's service territory includes numerous trees, many of its member-consumers find siting solar systems challenging. WHCEA addressed this problem through community solar, which allows more favorable siting options. Its first community solar project in 2013 was a 32-kW array; WHCEA worked with CEC to monetize the tax incentives utilizing a tax equity flip. It coordinated more recent projects with CoBank.

Its community solar projects have been well received. The first project was subscribed quickly and a subsequent project sold out in months. At the time of these early projects, the only option offered was a prepayment of project costs by subscribers. The cooperative funded its later projects, and currently is able to offer the following pricing options to members on a per-panel basis:

Option 1: $0 down, but a fixed power price per kWh for 20 years

Option 2: An upfront payment per panel and $0 per kWh

Option 3: $0 down, but signing a contract for solar will allow 4% savings off the general service rate

Each option has a different risk level, with the lower risk reflected in a lower return. Part of that return is based on the assumption of future power supply rate increases over the next 20 years. The prepay option provides the largest benefit, followed by the fixed price/kWh option, and the 4% option, which offers the lowest return.

Subscribers need to be reasonably creditworthy; some credit assurance is needed, but detailed credit checks are not required. The cooperative has funded its next program and anticipates reasonable rate increases for power supply in the future. Although the fixed price/kWh is currently higher than the general rate, it is expected to drop over time. WHCEA's development of community wind projects has followed a model of developing projects as member-consumers commit to the cost. Solar array projects are typically supplied and installed by third parties, with WHCEA crews providing the interconnection work.

WHCEA is not promoting individual rooftop solar at this time, but if a member-consumer is interested, it has identified reputable contractors and provides its member-consumers with some guidance on how to proceed. Steve Nisbet, WHCEA's Vice President of External Relations & Power Solutions, has explained that the long-term business model of rooftop solar for a cooperative is still in question.

(continued)

Wright-Hennepin Cooperative Electric Association (WHCEA) (continued)

Nisbet's current perspective is that community solar looks like a utility-planned investment — initial returns are not attractive, but the cash flow provides a reasonable investment case in the long term. He added that WHCEA's current subscription costs generally cover the cost of the solar projects for member-consumers and are intended to avoid or minimize cross-subsidies. An important goal is to be able to tell other member-consumers that solar subscribers are carrying their weight.

WHCEA's solar endeavors have grown over the years. Currently, it has 395 kW of community and research and development (R&D) solar projects, with another 150 kW of community solar coming online soon. In addition, WHCEA is adding another 2.25 MW of utility-scale solar, which is considered part of WHCEA's portfolio of power supply.

Although past capacity factors have averaged 14.5%–15% of nameplate on existing projects, the planned projects are cautiously anticipating an 18% net capacity factor. However, Nisbet cautioned that projecting capacity factors is uncertain and must recognize that weather patterns are variable.

Nisbet is planning to develop a formal valuation of the solar power generated in WHCEA's next cost-of-service study. Currently, the value of generation from the solar project is primarily considered an offset to purchased power costs. The only distribution issue identified thus far was with one feeder, which had a slight potential for problems.

Nisbet offered the following suggested tips for marketing a solar program to member-consumers:

- Listen to member-consumers about what they are willing to do.
- To sell to the member-consumer, get the internal staff on board. They need to understand and believe in it.
- Avoid preconceived notions of who will or will not be interested. The co-op may be surprised at who decides to participate.

When asked about lessons learned, Nisbet also offered the following:

- Subsidies, whether a tax credit or something else, seem to encourage installers to make higher bids. Be alert for that risk and try to address it.
- Address internal opposition early and get the team on board.
- Be cautious about raising expectations within the organization and among member-consumers.
- Do not ignore the legal, regulatory, and permitting implications. These issues are difficult to control and can delay or kill good projects.

APPENDIX

Task List Overview

This checklist should provide an overview of most of the tasks that cooperative managers should bear in mind as they consider a residential solar program. Although third-party outsourcing may be helpful, or even necessary, some tasks must remain internal to the cooperative.

Table 4: Task List

		Co-op	Third Party
DEVELOP BUSINESS PLAN	Value Statement		
	Market Analysis		
	Choose Model		
	Financial Economic Analysis		
	Board Approval		
PROGRAM IMPLEMENTATION	Establish/Contract with Partners		
	Develop Marketing Campaign		
	Develop Sales On-Boarding Process		
	Implement and Test Software		
MARKETING PROGRAM	Initial Marketing		
	Capture Consumer-Member Interest		
	Secondary Marketing Campaign		
PRE-SALE TASKS	Rooftop Review		
	Credit Review (if doing financing)		
	Community Solar Comparison		
	Sign Contracts		
INSTALL SYSTEM	Physical Installation		
	Codes and Standards Review/Approval		
	Interconnection		
RECORD KEEPING	Billing		
	Power Production		
MEMBER-CONSUMER MAINTENANCE	Operation and Maintenance		
	Customer Service		
	System Replacement/Removal		