Insights from the Colorado Energy Office Low-Income Community Solar Demonstration Project

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ACRONYMS AND ABBREVIATIONS

ACEEE	American Council for an Energy-Efficient Economy
AMI	Area Median Income
CARE	Colorado's Affordable Residential Energy
CEO	Colorado Energy Office
CIP	Crisis Intervention Program
CHFA	Colorado Housing and Finance Authority
Demonstration Project	Low-Income Community Solar Demonstration Project
DMEA	Delta-Montrose Electric Association
EEA	Empire Electric Association
EOC	Energy Outreach Colorado
FMR	Fair Market Rate
FPL	Federal Poverty Level
GHG	Greenhouse gas
GVP	Grand Valley Power
HCE	Holy Cross Energy
HUD	U.S. Department of Urban Housing and Development
IOU	Investor-Owned Utility
ITC	Investment Tax Credit
kW	Kilowatt
kWh	Kilowatt Hour
LCOE	Levelized Cost of Energy
LEAP	Low-Income Energy Assistance Program
LIHEAP	Low-Income Home Energy Assistance Program
Lotus	Lotus Engineering and Sustainability, LLC
MACRS	Modified Accelerated Cost Recovery Schedule
MOU	Memorandum of Understanding
MW	Megawatt
NAACP	National Association Advancement of Colored People
NEEP	Non-Profit Energy Efficiency Program
NREL	National Renewable Energy Laboratory
NYSERDA	New York State Energy Research and Development Authority
OBF	On-Bill Financing
OBR	On-Bill Recovery
O&M	Operation and Maintenance
PPAs	Power Purchase Agreements
PRPA	Platte River Power Authority

PTC	Production Tax Credit
PUC	Public Utilities Commission
PURPA	Public Utility Regulatory Policies Act
PV	Photovoltaic
PVREA	Poudre Valley Rural Electric Association
RECs	Renewable Energy Credits
RPS	Renewable Portfolio Standard
SMPA	San Miguel Power Association
WACC	Weighted average cost of capital
WAP	Weatherization Assistance Program
YVEA	Yampa Valley Electric Association

Executive Summary

The Colorado Energy Office (CEO) has administered the state-wide weatherization program for 40 years, as directed by the U.S. Department of Energy. The weatherization team has focused on energy conservation measures that reduce heating costs. While impactful, heating costs (usually natural gas or propane consumption) only make up approximately 50 percent of the total energy bill for most low-income households that are weatherized in Colorado. The other 50 percent of the bill comes from electricity costs. Since much of a household's natural gas and propane costs can be reduced with weatherization services, CEO has committed to finding ways to reduce electricity costs through energy efficiency and renewable energy.

CEO recognized the potential for community solar to reduce low-income energy burden and initiated the Low-Income Community Solar Demonstration Project (Demonstration Project). CEO awarded GRID Alternatives -- a non-profit focused on providing solar power to low-income families -- a $1.2 million grant to implement the development of eight demonstration models throughout Colorado with non-regulated utilities. The Demonstration Project was designed to help reduce energy burden for over 300 low-income households and better understand how utility and project structures affect the ability to make low-income community solar beneficial for both utilities and low-income subscribers. CEO's Demonstration Project shows the feasibility of building a low-income community solar model that can be repeated throughout the United States, reducing the energy burden for all low-income households.

Utility Partners and Results

CEO and GRID worked with eight utility partners including Empire Electric Association, Delta-Montrose Electric Association, Fort Collins Utilities, Grand Valley Power, Holy Cross Energy, Poudre Valley Rural Electric Association, San Miguel Power Association, and Yampa Valley Electric Association and (see Figure 1). Together these utilities serve 19 of the 64 counties in Colorado.

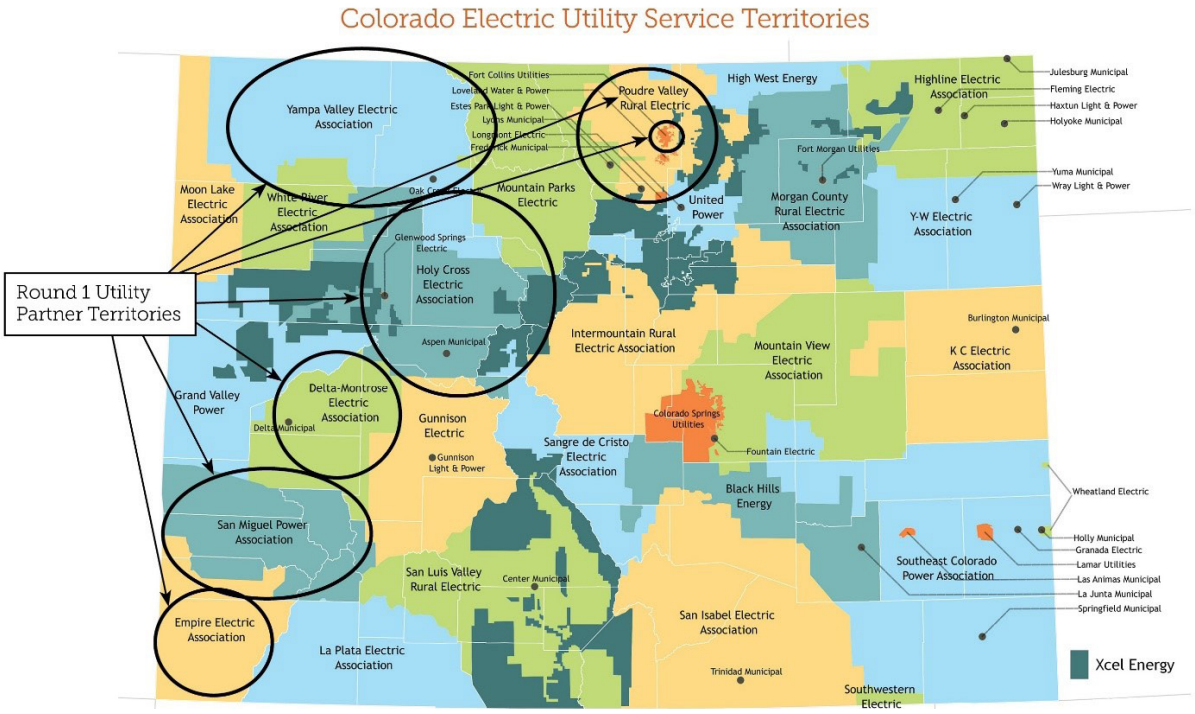

FIGURE 1. CEO COMMUNITY SOLAR DEMONSTRATION PROJECT PARTNERS

Each project was designed differently to help identify optimal utility project structures and to identify opportunities for implementation in investor-owned utility territories. While each project provided a distinct set of lessons learned and policy recommendations, one item remained consistent -- each subscriber greatly benefited from the program and saved 15 to 50 percent on his or her electricity bills. These savings equated to, on average, $382 per subscriber. It is expected that the project will reduce electricity costs for the 380 subscribers by over $145,160 in the first year and more than $3 million over the lifetime of the project. For more information on each of the project structures and resulting savings see subsection *Project Evaluation*.

"The Community Solar project is a worry-free, win-win situation for us. The program is a great alternative to rooftop solar. We will see significant cost savings and reduce our environmental impact, which is a wonderful blessing all around."

– John Castilla, subscriber of Holy Cross Energy array

Table 1 shows the portfolio of community solar projects that collectively comprise the Demonstration Project. For each community solar array in the portfolio, this table lists the utility partner, the size of the community solar array, the number of low-income households benefiting directly from the array, the average low-income household subscription in kilowatts, and the subscription period for each low-income household subscriber.

As of October 2017, 380 households were benefiting from 1,485 kW of community solar, surpassing the original project goals of 300 impacted households. The average subscription size ranges from 3.2 to 5.0 kW, and most projects will offset up to 100 percent of the subscribers' electricity usage.

Utility	Project Cost	Project Size (kW)	Households	Average Subscription Size	Targeted Usage Savings as Percentage of Utility Bills	Targeted Cost Savings as Percentage of Utility Bill	Subscription Period	Wholesale Provider
Delta-Montrose Electric Association	$315,900	151.1	43	3.6	Up to 100%	50%	5 Years	Tri-State Generation and Transmission
Empire Electric Association	$78,750	26.4	7	3.7	Up to 100%	50%	5 Years	Tri-State Generation and Transmission
Fort Collins Utilities	$195,000	63.6	30	3.2	Up to 100%	50%	1 Year	Platte River Power Authority
Grand Valley Power	$55,250	36.5	10	3.2	Up to 90%	50%	4 Years	Xcel Energy
Holy Cross Energy	$400,099	144.7	45	3.3	Up to 75%	15-50%	2 Years	Xcel Energy
Poudre Valley Rural Electric Association	$1,375,000	700.0	140	5.0	Up to 100%	30%	4 Years	Tri-State Generation and Transmission
San Miguel Power Association	$465,000	197.2	60	2.0	Up to 100% of 2 kW	50% of 2 kW	5 Years	Tri-State Generation and Transmission
Yampa Valley Electric Authority	$333,416	165.0	45	3.5	Up to 100%	50%	5 Years	Xcel Energy, Western Area Power Administration
SUM	$3,218,415	1,484.5	380					

TABLE 1: OVERVIEW OF PROJECTS

Each of the eight utility partners experienced significant qualitative benefits including (but not limited to): marketing opportunities; meeting renewable energy goals and regulations; reducing costs for low-income households; reducing the risk of non-payments, and increasing their knowledge of solar procurement and ownership. Depending on how each project was structured and how utilities subsidized the project, the utilities experienced different net incomes. For more information on the many benefits utilities and subscribers experienced, see subsection *Participation Drivers*.

"YVEA is proud to help develop a renewable energy project that touches so many people. This project is a perfect pilot for YVEA-owned solar generation—allowing a portion of our membership that often can't access renewable energy to benefit at an affordable cost, helping students and trainees who are building careers in the industry, and bridging what is sometimes a divide between solar advocates and utilities. We believe that many 'right' answers exist for the future of energy, and we expect to embrace varied and innovative fuel choices."

– Diane Johnson, Yampa Valley Energy Electric Association CEO

In summary, the Demonstration Project made clear that by implementing the right combination of programmatic best practices and policy improvements for community solar programs, low-income subscribers will be better served, utilities will benefit, and the strength and sustainability of the community solar program will be improved. For more information on the best practices see the following subsections: *Review of Financial, Utility, and Project Structure Variables, Summary of Programmatic Considerations,* and *Summary of Policy Considerations*. Additionally, see *Appendix B: Alternative Utility Project Structure for Solar* for more information.

1. Report Introduction

Approximately 30 percent of households in Colorado have an energy burden that is considered disproportionate to their income levels (paying more than 4 percent of their income on utility bills).[i] (Please note that throughout the document both footnotes and endnotes are used. Endnotes, such as that appears at the end of the prior sentence, are used to indicate a reference for the sentence; endnotes are indicated with roman numerals and are referenced at the end of the document in *Appendix D: End Note References*. Footnotes will provide further details regarding the information in the text, and are marked with arabic numerals). Of that 30 percent, 11 percent have a significant energy burden and are considered energy impoverished (paying more than 10 percent of their income on utility bills).[ii] Increasing energy costs alongside wages that remain steady have increased the number of households experiencing severe energy burden, and this trend is expected to continue. In response, many local, state, and federal programs have tried to address the problem through energy efficiency programs and financial assistance.

In Colorado, the Colorado Energy Office's (CEO) Weatherization Assistance Program (WAP) and Colorado's Low-Income Energy Assistance Program (LEAP) have made great strides in lessening energy burden, primarily by reducing home heating costs. However, average heating costs (usually from natural gas or propane consumption) account for only 50 percent of total household energy costs while the other 50 percent of the energy bill generally comes from electricity costs. Therefore, the effect of these programs, while impactful, is limited.[iii]

Over the last decade, the cost of solar electricity has drastically decreased and has made the cost of solar energy significantly more cost-competitive with its conventional fossil-fuel counterparts, both for the utility and end-user. Alongside this trend, a conversation nationwide has started that focuses specifically on how to ensure low-income households benefit from solar. In response, government entities and households have started exploring the many ways to procure solar power (i.e. power purchase agreements, solar leases, direct-owned, community solar, etc.) to reduce household energy burden. Though there are several ways to procure solar energy, the structure of community solar gardens is especially attractive when addressing the unique needs of low-income subscribers. Several notable benefits include access to immediate cost savings; lower installation and operation and maintenance (O&M) costs; suitability to multi-family housing units; and off-site panel location.[1] Throughout this report, 'co-ops' or 'electrical co-operatives' refer to an independent utility owned by its customers. 'Municipal utilities' refers to electric providers that are organized as home rule or statutory entities within a municipal government. 'IOUs' refers to investor-owned utilities that must comply with Public Utilities Commission (PUC) regulations.

In 2010, the Colorado State Legislature recognized that community solar gardens presented an excellent opportunity to increase solar energy investment while reducing electricity costs for low-income households (Colorado Revised Statute 40-2-127)[2]. In return, former Governor Bill Ritter passed the Community Solar Gardens Act (House Bill 10-1342)[3] that encouraged utilities to include low-income subscribers. Through the PUC rulemaking process, the bill required that subscribing organizations (i.e. solar garden developers) allocate at least 5 percent of each community solar garden to low-income subscribers (to the extent that there is demand for such ownership), creating the community solar low-income carve-out. While the Community Solar Gardens Act only affected Colorado's IOUs (i.e. Xcel Energy and Black Hills Energy), numerous municipal utilities and co-operative utilities around Colorado have also implemented solar gardens to support low-income households.

In 2015, Lotus Engineering and Sustainability, LLC (Lotus) evaluated the implementation of the low-income carve-out mandate in House Bill 10-1342. Results from this study were reported in the *Analysis of the Fulfillment of the Low-Income Carve-Out for Community Solar Subscriber Organizations*.[4] Though all subscribing organizations were meeting the carve-out requirement, several program barriers created an artificial cap, preventing significant expansion beyond the 5 percent carve-out. For example,

[1] Much of this assessment is based on anecdotal evidence from developers, municipalities, subscribers, and from Lotus' own experience in reviewing community solar garden project proposals.

[2] For more information see: https://leg.colorado.gov/sites/default/files/images/olls/crs2016-title-40.pdf

[3] For more information see: https://leg.colorado.gov/sites/default/files/images/olls/2010a_sl_344.pdf

[4] For more information see: https://www.colorado.gov/pacific/sites/default/files/atoms/files/Low-Income Community Solar Report-CEO.pdf

to maintain compliance with the carve-out, community solar garden developers donated 5 percent of each garden to qualifying households and recouped the lost revenue by increasing rates to their paying customers. This led to an unsustainable financial model for all involved, and instead of providing a benefit to all customers, this policy can lead to caps or ceilings on the amount of renewable energy and benefits available to low-income customers.

In 2015, CEO launched the Demonstration Project to explore the feasibility of building 100 percent low-income community solar models that significantly reduce low-income households' energy burden. The project's goal was never to eliminate electricity costs but instead to have low-income households reach bill parity where they spend a similar percentage (4 percent or less) of their annual income as middle and upper-income households do on energy bills. GRID Alternatives was awarded a $1.2 million grant from CEO to implement the project.

In 2016, CEO contracted with Lotus to evaluate how, and if, individual community solar projects could effectively reduce energy burden for our most vulnerable communities -- those that pay more than 4 percent of their income on utility bills -- and if this work could be replicated across the United States.

To complete this analysis, Lotus created discrete case studies for each individual community solar project (see *Appendix A: Model Case Studies*). Each project was evaluated for effectiveness, challenges, successes, and best practices from both the perspective of the utility and the community solar subscribers. This information is intended to inform government agencies, utility companies, and policy-makers on how to design effective low-income community solar projects with respect to a region's unique situation and needs.

Lotus was also tasked with completing a Demonstration Project Evaluation (this report) that synthesized the entire two-year long effort by CEO and GRID to reduce costs for low-income households through community solar. This report provides:

- a summary of total project impact on energy burden, including an analysis of subscriber cost and energy savings achieved through the application of both weatherization services and community solar;
- summary of each project's structure, including a comparison of the impact on energy burden and an explanation regarding variability on impact;
- a list of programmatic and policy considerations and procedures; and
- a full analysis of low-income community solar policy considerations based on project outcomes.

The goal of this evaluation is to provide a framework for developing low-income community solar programs that utilities, state energy offices, government agencies, and policy-makers can pursue at scale and replicate across the state and the country.

1.1 Analysis Methodology

To better understand the concept of energy burden and how community solar could address the problem, Lotus completed original research and interviewed individuals whose organizations have direct experience working with community solar, low-income communities, and/or solar policy. In addition, Lotus interviewed each utility and a subscriber from each utility project (see Table 2). Lastly, Lotus reviewed numerous studies that are referenced throughout the report as noted in *Appendix D: End Note References*. Much of this report is based on opinions received through various interviews, and every attempt has been made to accurately represent the information shared by each participant.

Organization	Interviewee	Expertise
Arapahoe County Weatherization	Steve Elliott	Weatherization expert
Clean Energy States Alliance	Nate Hausman	Non-profit organization
Colorado Energy Office	Ryan Harry and Joseph Pereira	State Energy Office
Colorado's Low-Income Energy Assistance Program (LEAP)	Aggie Berens	State government organization providing federal funding for heating
Department of Energy	Odette Mucha	National organization, low-moderate income solar expert
GRID Alternatives	Emily Birk, Chuck Watkins, and Tom Figel	Non-profit organization, working with CEO on community solar, solar installer
National Renewable Energy Lab	Alexandra Aznar, Liz Doris, Douglas Gagne	National Laboratory with expertise in solar energy
New York State Energy Research and Development Authority (NYSERDA)	Max Joel	Utility, low-moderate income expert
Posada	Anne Stattelman	Non-profit housing authority, familiar with low-moderate income needs and community solar programs
Rocky Mountain Institute	Kevin Brehm	Think tank, low-moderate income expert for solar
Solar Energy Industries Association	Mike Mendelson	Industry expert
The Atmosphere Conservancy	Alex Blackmer	Non-profit organization, solar finance expert
Vote Solar	Jessica Scott and Melanie Santiago-Mosier	Solar policy experts
Keyes & Fox LLP	Scott Dunbar	Distribution generation and renewable energy law; expert on Public Utilities Regulatory Policies Act
Utility	**Interviewee**	**Expertise**
Delta-Montrose Electric Association	Jim Heneghan, Renewable Energy Engineer	Utility
Delta-Montrose Electric Association	Steve and Sue Sidebottom	Subscribers
Empire Electric Association	Josh Dellinger, General Manager, and Clint Rapier, System Engineer	Utility
Empire Electric Association	Lloyd Gallion	Subscriber
Fort Collins Utilities	John Phelan	Utility
Fort Collins Utilities	Laura Wilson	Subscriber
Grand Valley Power	Derek Elder and Matt Williams	Utility
Grand Valley Power	Gloria Martinez	Subscriber
Holy Cross Energy	Christopher Hildred, Laura Reed	Utility
Holy Cross Energy	John Castilla	Subscriber
Poudre Valley Rural Electric Association	Milton Geiger	Utility
San Miguel Power Association	Brad Zaporski, Wiley Freeman	Utility
San Miguel Power Association	Evelyn Nelson	Subscriber
Yampa Valley Electric Authority	Amy Mahon, Diane Johnson, Larissa Wilson	Utility
Yampa Valley Electric Authority	Julie Carey	Subscriber

TABLE 2: LIST OF INTERVIEWEES

2. Project Drivers

2.1 Project Background and Objectives

CEO has committed to finding ways to reduce electricity costs through both energy efficiency and renewable energy. As discussed in the *Colorado Community Solar* subsection, through the 5 percent low-income carve-out outlined in the PUC rulemaking from House Bill 10-1342, community solar is already benefiting hundreds of low-income households throughout Colorado; yet, there is little incentive for developers to exceed the low-income carve-out, thus creating an artificial cap.[iv] CEO hopes that through their Demonstration Project they can show that community solar is an effective way to reduce household energy burden for our most vulnerable communities.

2.1.1 Poverty Classification

Approximately 14 percent of all American families live in poverty.[v] Determining the extent to which a household lives in poverty is a function of the household's income to the area's median income (AMI) as defined by the U.S. Department of Urban Housing and Development (HUD)[5] or as defined by the Colorado Housing and Finance Authority (CHFA)[6] . CEO uses the following definitions:

- Low to moderate-income: Households making up to 80 percent of AMI.
- Very low-income: Households making up to 50 percent of AMI.
- Extremely low-income: Households making up to 30 percent of AMI.

Poverty may also be classified using the federal poverty level (FPL), whereas a household's income is compared to a national poverty level (e.g. 165 percent of FPL). CEO's WAP provides free energy efficiency services to households that earn at or below 200% FPL.

Nationally, a variety of low-income support programs have been created to help ease the burden of poverty. Programs may qualify participants using AMI-based or FPL-based poverty classifications. Conversations with local energy-efficiency program managers indicate that the AMI classification is the more inclusive in Colorado. The FPL-based classification includes national averages, and it can be too exclusive when attempting to reach members of the low-income community across states. For comparison, 80 percent of AMI for a household of four in Colorado may range from around $48,000 to $64,000, whereas 165 percent of FPL for a household of four is $40,095 regardless where the family resides.[vi,vii] Some organizations suggest using a Self-Sufficiency Standard, defined as the level at which households can maintain basic needs without financial assistance. The Colorado Self-Sufficiency Standard is equal to 200 percent of the FPL or $48,600.

2.1.2 Poverty in Colorado

More than 12 percent of all Colorado families live in poverty, with disparities across county lines: Douglas County has the lowest poverty rate at 3.4 percent and Crowley County has the highest poverty rate at 44.3 percent (see Figure 2; for a larger version of this figure please see *Appendix C: Additional Figures)*. Of the 12 percent of Colorado families living in poverty, 46 percent of those Coloradoans live in "deep poverty," with a household income of 50 percent or less than the state poverty level.[viii]

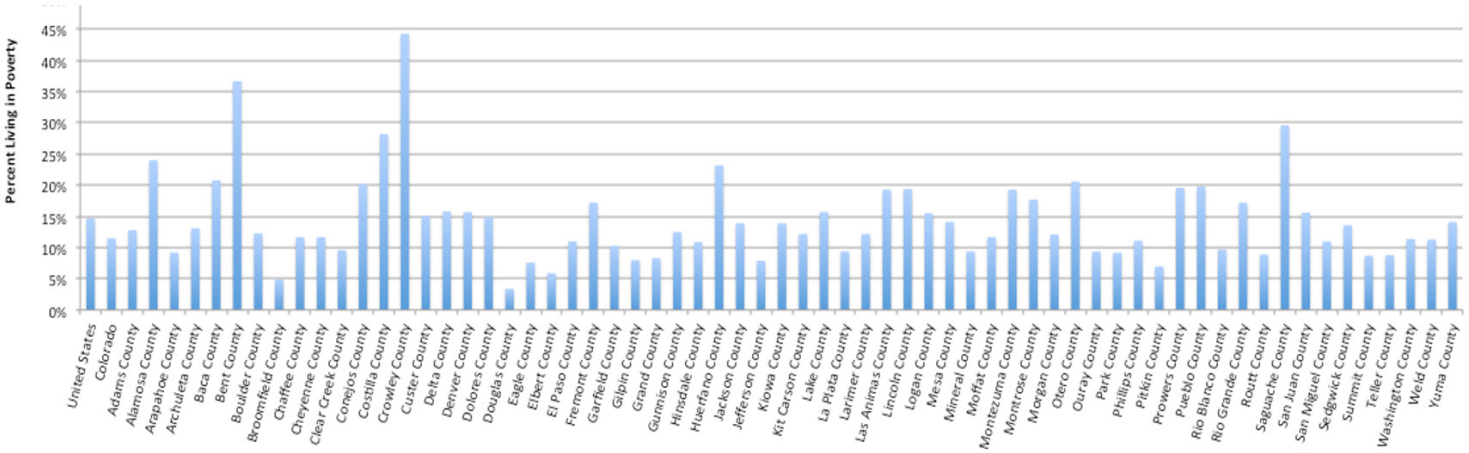

FIGURE 2: PERCENT OF COLORADO RESIDENTS LIVING IN POVERTY BY COUNTY[IX]

[5] For HUD's income levels see: https://www.huduser.gov/portal/datasets/il/il16/index_il2016.html.

[6] For CHFA's income levels see: https://www.chfainfo.com/arh/asset/Documents/2014_income_limits.pdf. CHFA income levels are specific to the State of Colorado and may be a more accurate representation of Colorado income levels than HUD's estimates.

Racial and ethnic factors play a significant role in income disparities. The Colorado poverty rate is 8.7 percent for white households, 9.3 percent for Asian households, 19.5 percent for African-American households, 20.6 percent for American Indian/Alaskan Native households, and 21.4 percent for Latino households. White households also typically earn more and see their wages increase faster than non-white households.[x]

2.1.3 National and Colorado Income Patterns

Those living in poverty often experience basic cost-of-living increases year after year, even when wages stay relatively flat. Data from the Consumer Price Index show that total inflation was over 250 percent between 1979 and 2016,[xi] and the Pew Charitable Trust reported that low-income household housing costs increased by 50 percent since the late 1990s.[xii] Yet wages have not kept up: income for the bottom 90 percent of earners increased only 15 percent between 1979 and 2013.[xiii]

Fortunately, Colorado's economy is outpacing national averages. Recently, Colorado has seen increases in the number of jobs and annual income, and the state's poverty rate has fallen to its lowest level in ten years.

Though progress is being made, Colorado has a long way to go to relieve poverty and energy burden for many households. According to the National Low-Income Housing Coalition, a worker must make an average of $21.12 per hour in a 40-hour work-week to afford a Fair Market Rate (FMR) two-bedroom rental in Colorado; yet, the median hourly wage in Colorado is $18.64. [xiv, xv] In addition, Colorado households that make the least amount of money see the smallest increase in wages over time.

2.1.4 National Energy Burden

Household costs are approximately one-third of total living expenses for low-income households, and energy costs make up a substantial portion of these expenses.[xvi] The percentage of household income spent on energy consumption to total household income is defined as energy burden.

CEO's WAP team provided the following Colorado-specific definitions to classify the varying degrees of energy burden:

- Energy stressed: Energy burden between 4 percent and 7 percent of annual income.
- Energy burdened: Energy burden between 7 percent and 10 percent of annual income.
- Energy impoverished: Energy burden greater than 10 percent of annual income.

Not all households that experience high-energy burden are classified as low-income. Some moderate- and high-income households also spend a good portion of their income on energy use.

The national low-income energy burden is between 6 percent and 15 percent, whereas the national average non-low-income household energy burden is about 2 percent. The American Council for an Energy-Efficient Economy (ACEEE) calculated a national median low-income energy burden of about 7 percent, and low-income advocates suggest that energy burden should not exceed 4 to 6 percent.[xvii] See Table 3.

	Household Type	Median Annual Income	Median Size of Unit (sq. ft.)	Median Annual Utility Spending	Median Annual Utility Cost per Sq. Ft.	Median Energy Burden
Income Type	Low-Income (<80 AMI)	$24,998	1,200	$1,692	$1.41	7.2%
	Non Low-Income	$90,000	1,800	$2,112	$1.17	2.3%
	Low-Income Multifamily (<80 AMI)	$21,996	800	$1,032	$1.29	5.0%
	Non Low-Income Multifamily	$71,982	950	$1,104	$1.16	1.5%
Building Ownership	Renters	$34,972	1,000	$1,404	$1.40	4.0%
	Owners	$68,000	1,850	$2,172	$1.17	3.3%
Race	White	$58,000	1,600	$1,956	$1.22	3.3%
	African-American	$34,494	1,290	$1,920	$1.49	5.4%
	Latino	$39,994	1,200	$1,704	$1.42	4.1%
All Households	N/A	$53,988	1,573	$1,932	$1.23	3.5%

TABLE 3: SUMMARY OF ENERGY BURDEN ACROSS 48 LARGE U.S. CITIES[xviii]

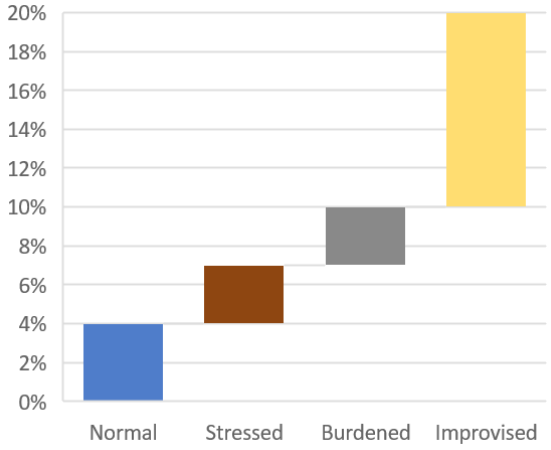

FIGURE 3: SUMMARY OF ENERGY BURDEN CATEGORIES

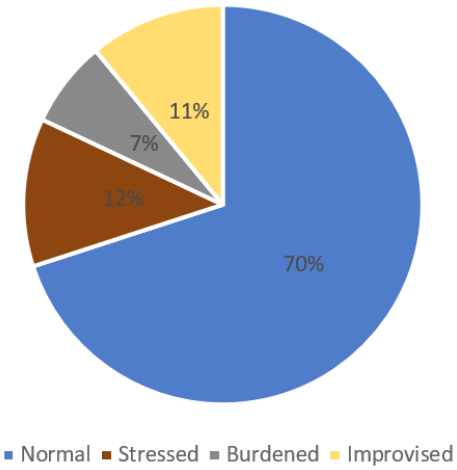

FIGURE 4: SUMMARY OF ENERGY BURDEN SEVERITY

Localized low-income energy burden can be much higher. The ACEEE found that 25 percent of all low-income households live in extreme energy poverty, with an energy burden greater than 14 percent.[xix]

The ACEEE singled out white, African-American, and Latino households in their analysis (see Table 3) and found that communities of color typically pay more in energy costs than their white peers. Reducing energy burden can also help address environmental justice issues, a conclusion supported by the National Association Advancement of Colored People (NAACP). The NAACP's report, *Just Energy Policies*[7], states that communities of color bear a bigger brunt of fossil fuel impacts: poorer health quality and closer proximity to polluting power plants, while having fewer jobs in and less direct economic benefit from the fossil fuel industry.[xx]

2.1.5 Energy Burden in Colorado

According to CEO, nearly 700,000 Colorado households (30 percent of all Colorado households) experience significant energy burden: spending more than 4 percent of their annual income on utility bills.[xxi,xxii] See Figure 3 and Figure 4.

Colorado's significantly energy-burdened population spends on average between 4 percent and 20 percent of annual income on energy costs. In some localized areas, this percentage is even greater. Posada, a non-profit low-income housing organization located in Pueblo, reported several cases in which low-income households paid a utility bill that exceeded their rent payment and, at times, reached up to a thousand dollars per month. And according to a study completed by the University of Colorado at Denver, utility costs were the fourth most common reason for homelessness after loss of job, housing costs, and family/relationship breakup.[xxiii]

Fortunately, energy burden rates may be decreasing slightly. Using energy burden rates for Colorado households living in deep poverty (i.e. households living at 50 percent of the poverty line) as an indicator, high-energy burden rates have decreased between 2011 and 2015.

As shown in Figure 5, energy burden rates increased in 2013, although it is not clear what caused this singular increase; all other years follow a similar pattern (See *Appendix C* for a larger version of Figure 5).

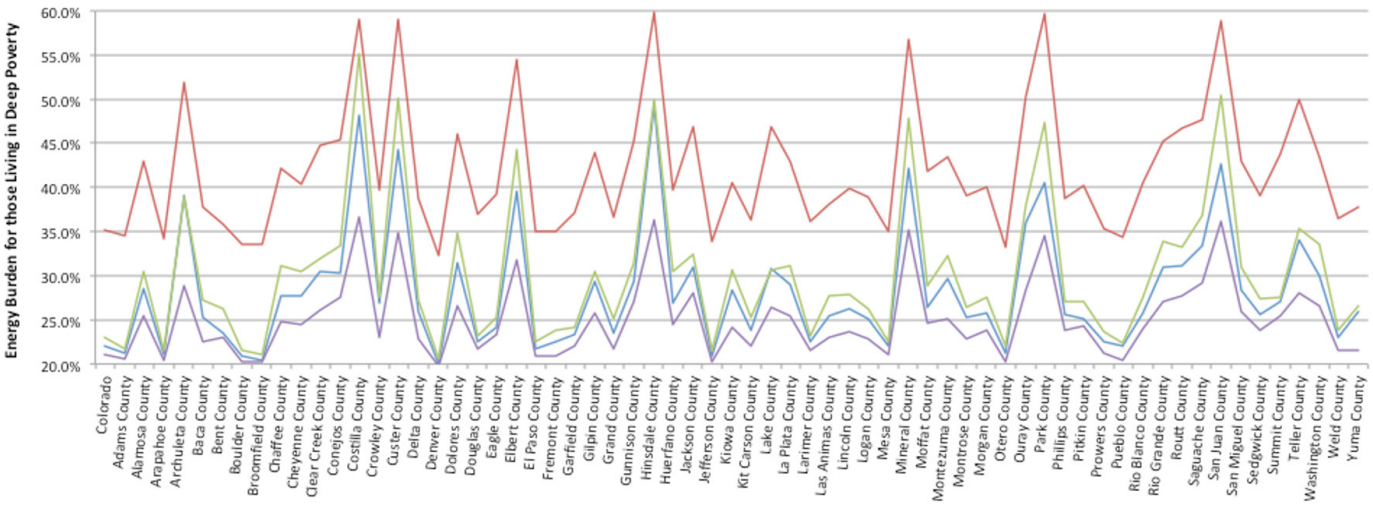

FIGURE 5: ENERGY BURDEN RATES FOR THOSE LIVING IN DEEP POVERTY OVER TIME[xxiv]

[7] For the NAACP report, please see: http://www.naacp.org/wp-content/uploads/2014/03/Just-Energy-Policies_Model-Energy-Policies-Guide_NAACP.pdf

2.2 Colorado's Energy Costs

Colorado has 57 electric utilities: two IOUs, 29 municipal utilities, and 26 co-operative utilities (See Figure 6).[xxv] Electric rates vary for each utility and each utility type.

In 2016, Southwestern Electric Coop Inc. charged the highest residential electricity rate at $0.204545 per kilowatt hour (kWh) and the City of Fort Morgan had the lowest electricity rate at $0.089211 per kWh. The state's average electric rate was $0.132668 per kWh. See Table 4.

Of the utilities that released data, the five with the highest residential electricity rates were:

1) Southwestern Electric
2) Sangre De Cristo Electric
3) Southeast Colorado
4) San Luis Valley Rural Electric
5) San Isabel Electric Association.

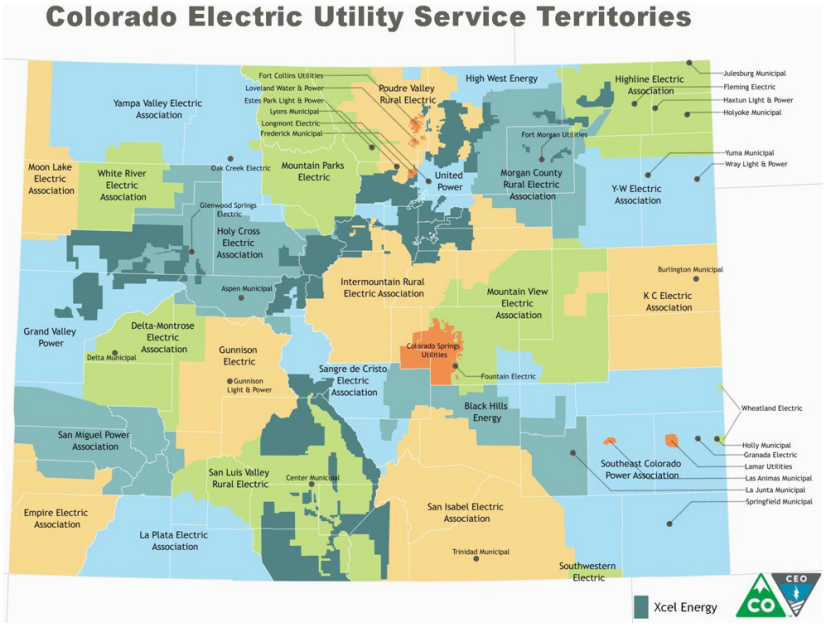

FIGURE 6: COLORADO'S ELECTRIC UTILITIES

Utility Type	Utility	Residential Electricity ($/kWh)	Utility Type	Utility	Residential Electricity ($/kWh)
Investor-Owned Utility	Black Hills Energy	$0.15743	Municipal Utility	Aspen	$0.13295
	Xcel Energy	$0.11470		Burlington	$0.14330*
Cooperative Utility	Delta-Montrose	$0.13557		Center	$0.07620
	Empire	$0.10529*		City of Fountain	$0.09898*
	Grand Valley	$0.14052		Colorado Springs	$0.12034
	Gunnison County	$0.12732*		Delta	$0.08950
	High West	$0.13475		Estes	$0.10890*
	Highline Electric	$0.13224		Fleming	$0.04058
	Holy Cross	$0.09849*		Fort Collins	$0.10097
	Intermountain	$0.13050		Fort Morgan	$0.08921
	K.C. Electric	$0.13309		Fountain	$0.10075
	La Plata	$0.15423		Frederick	$0.12478
	Moon Lake	$0.06150		Glenwood Springs	$0.10806
	Morgan County	$0.13874		Granada	$0.12000
	Mountain Parks	$0.14355		Gunnison	$0.09277
	Mountain View	$0.14017		Haxtun	$0.10071
	Poudre Valley	$0.11633		Holly	$0.15700
	San Isabel	$0.16459		Holyoke	$0.09016
	San Luis	$0.16911		Julesburg	$0.08200
	San Miguel	$0.15590		La Junta	$0.08900*
	Sangra de Cristos	$0.17141		Lamar	$0.12300*
	Southeast Colorado	$0.16976		Las Animas	$0.12830*
	Southwestern Electric Coop Inc.	$0.20455		Longmont	$0.09293
	Tri-County	$0.14706		Loveland	$0.09727
	United Power	$0.12178		Lyons	$0.09500
	Wheatland	$0.12433*		Oak Creek	$0.08875*
	White River	$0.11832		Springfield	$0.14100*
	Yampa Valley	$0.11366		Trinidad	$0.12630
	Y-W Electric	$0.14272		Wray	$0.10970*
				Yuma	$0.09320*

It should be noted that the values presented in Table 4, unless noted otherwise with an asterisk (*), were taken from the U.S. Energy Information Administration or OpenEI.org and do not always match the residential retail rate reported by the actual utility. Values followed by an asterisk (*) reflect rates reported by the actual utility.

TABLE 4: COLORADO'S RESIDENTIAL ELECTRICY RATES[xxvi]

The five counties with the highest energy burden rates include:

1) Costilla County;
2) Hinsdale County;
3) San Juan County;
4) Mineral County; and
5) Custer County.

In 2016, Colorado's average residential retail rate was approximately 9 percent less than the national 2016 average.[xxvii] Costs may be lower due to low natural gas prices; natural gas is used to generate approximately one-quarter of Colorado's electricity.[xxviii] Most, if not all, utility companies are expected to continue raising rates. Colorado has seen an average annual increase in residential electricity rates of 3.3 percent between 2001 and 2016.[xxix] During the same time period average adjusted income increased by just 0.9 percent.[xxx] The struggle to pay energy costs will continue for most, if not all, low-income households.

2.3 Programs and Policies Addressing Energy Burden

2.3.1 Overview

With reduced housing stock, growing population, and greater competition for housing units, low-income households that rent or own are typically forced to compromise housing quality for affordability. This means living in older buildings with greater inefficiencies. On average, low-income households see energy costs of $1.35 per square foot compared to non-low-income households who pay on average $1.165 per square foot (see Table 3). This is presumably a result of greater energy inefficiencies.

Many federal, state, and local programs and policies are attempting to address energy burden and to help ensure that low-income families can direct their dollars to other household expenses. Programs and policies can generally be broken into the following categories: bill assistance, tax rebates, emergency repair, grant programs, and weatherization services and now -- solar energy. Each program and policy may have different qualification requirements such as income, residency, age, housing type (multi-family or single-family), and heating type. In addition, each program and policy might have different benefit terms. For example, bill assistance is usually a one-time benefit, while solar is a long-term asset providing benefits for more than 20 years. See Table 5 for more information.

2.3.2 Federal Programs

The U.S. Department of Health and Human Service's Low-Income Home Energy Assistance Program (LIHEAP) and the U.S. Department of Energy's WAP are the two major federal energy burden programs in the United States. Together they have provided support to millions of households across the country.

2.3.2.1 Low-Income Home Energy Assistance Program (LIHEAP)

LIHEAP provides money to states, tribes, and territories to operate local programs that reduce energy costs related to heating and cooling (LIHEAP can only be used for cooling in determined states; Colorado cannot use funds for cooling). Approximately 15 percent of the funds can be used on weatherization (up to 25 percent with a waiver) and up to 5 percent can be used on home energy assessments. The remaining portion must be used to pay bills and administer the program (capped at 10 percent).[xxxi] States, tribes, and American territories are responsible for identifying eligible households and conducting outreach.

Congress appropriates LIHEAP funds each year, and the amount can vary significantly from one year to the next. In 2015, LIHEAP provided $3.39 billion in funding but, due to high need, LIHEAP was only able to benefit 22 percent of those eligible to receive the benefit or 6.9 million households.[xxxii]

In 2017, Colorado is expected to receive approximately $45.3 million in LIHEAP funding, which is down compared to $48.3 million received in 2015. To qualify for funding, Colorado families must have incomes at or below 165 percent of the FPL.[xxxiii] Funding is allocated through the Colorado LEAP program, which is managed by county departments of social/human services offices. See subsection titled *Colorado LEAP Program* for more information.

2.3.2.2 Weatherization Assistance Program (WAP)

Since the introduction of the WAP program, over 7 million households have received weatherization services, making it the nation's largest residential whole-house energy-efficiency program. Funding is provided through annual Congressional appropriation and is distributed annually throughout the United States, D.C., American territories, and tribes. The WAP program takes the "whole house weatherization" approach by focusing on the building envelope, heating and cooling systems, electrical system, and electric base load appliances.

Administrator	Program Name	Type of Program	Income Qualifications	Other Qualifications	Location Limitations (Colorado)
U.S. Department of Health and Human Services	Low Income Home Energy Assistance Program (LIHEAP)	Bill Assistance	An annual household income at or below 150% of the Federal Poverty Guidelines	Set by the states	Available statewide
U.S. Department of Energy	Weatherization Assistance Program (WAP)	Weatherization Program	An annual household income at or below 60% of the state median income	Set by the states	Available statewide
Colorado Department of Human Services	LEAP Program	Bill Assistance	An annual household income at or below 165% of the Federal Poverty Guidelines	*Pay home heating costs, either directly to utility or to a landlord as part of rent *Are a permanent legal resident of the United States and a Colorado resident or you have household members that are U.S. citizens *Provide proof of lawful presence in the U.S.	Available statewide
Colorado Department of Local Affairs	Community Services Block Grants (CSBG)	Grant Program	An annual household income at or below 125% of the Federal Poverty Guidelines	Affidavit of legal residency	31 eligible entities
Colorado Energy Office	Weatherization Assistance Program (WAP)	Weatherization Program	An annual household income that does not exceed 200% of the Federal Poverty Guidelines	House cannot have received weatherization assistance after September 1994	Available statewide
	Low-Income Community Solar Demonstration Project	Solar Energy	Utility specific	Utility specific	Limited to participating utilities
Colorado Department of Revenue	Property Tax/Rent/Heat Credit (PTC) Rebate	Tax Rebate	A single person with a total income of less than $13,234; or a married couple with a total combined income of less than $17,839	*Resided in Colorado the entire year *At least 65 years old or a surviving spouse at least 58 years old or disabled for all of 2016, regardless of age, and received benefits for the full year *You are not claimed as a dependent on any other person's federal income tax return	Available statewide
Energy Outreach Colorado	Crisis Intervention Program	Emergency Repair or Snow Removal	If you qualify for LEAP assistance	See LEAP requirements	Available statewide
	Colorado's Affordable Residential Energy program (CARE)	Bill Assistance	CARE recipients must have an income at or below 80% of AMI in their county	N/A	CARE is only provided in counties where their partners are located
	Non-Profit Facility Energy Efficiency Grants (NEEP)	Grant Program	N/A	*Are a 501(c) 3 non-profit program (some churches qualify) *Own a facility that demonstrates a need for efficiency improvements (long-term leases acceptable) *Serve low-income populations, including the elderly, people with special needs, and families with children *Pay the utility bills for the facility and have historic utility data *Currently use the facility	Available statewide
	Affordable Housing Energy Rebate Program	Grant Program	At least 67% of residents are below 80% AMI	*Available only for multi-family housing (minimum 2 units) *Heating systems can be individual or central	Limited to households in Sources Gas, Atmos, Colorado Natural Gas, and Xcel territory
	Affordable Housing Weatherization Program	Grant Program	At least 67% of residents (minimum of 2 units) are at or below 200% Federal Poverty Level	*Available only for multifamily housing (minimum 5 units) *Must have central heating *Will not qualify if weatherized after 9/30/1994	Available statewide

TABLE 5: SUMMARY OF HIGHLIGHTED PROGRAMS AND POLICIES ADDRESSING ENERGY BURDEN

The Department of Energy estimates that as many as 20 to 30 million American families are eligible for weatherization services. The average expenditure on weatherization services per house they service is $6,500. Each state sets its income requirements within Department of Energy guidelines. Services are provided by the states, which have slightly different criteria. In Colorado, CEO administers federal WAP funds and ensures that funds are used efficiently (see subsection titled *CEO Weatherization Assistance Program*).

2.3.3 Colorado-Specific Programs and Policies

2.3.3.1 Colorado LEAP Program

LEAP is a federally funded program that is administered by the Colorado Department of Human Services in the Office of Economic Security.[8] To qualify, a household must:

- pay home heating costs (directly or through their landlord);
- be permanent legal residents of the United States and the State of Colorado or have household members that are U.S. citizens;
- provide proof of lawful presence; and
- earn less than 165 percent of the federal poverty index.

LEAP covers a portion of winter energy costs. The amount of funding is dependent on a variety of factors including primary heating costs, available LEAP funding, and number of applicants received. To receive funds, LEAP applicants must submit paperwork to their local county LEAP office.[9] Benefits in fiscal year 2017 ranged from $200 to $700 a month for heating and a total of no more than $3,700 per year (includes a $700 crisis winter maximum). The total allocation in 2017 was $51 million. In fiscal year 2014, 90,005 households were served throughout Colorado and received the average benefit of $302. Of the households served, 28 percent had elderly residents, 31 percent had residents with a disability, and 26 percent had children under 5.[xxxiv]

2.3.3.2 CEO Weatherization Assistance Program

CEO WAP partners with eight local weatherization agencies to provide cost-effective energy efficiency services to low-income households across Colorado. The goal of the WAP program is to maximize energy cost savings for each client by using cost-effective improvement measures. Historically, CEO has focused mainly on reducing heat costs through energy efficiency. In 2016, the Department of Energy allowed CEO to integrate rooftop solar photovoltaics into weatherization services to further reduce utility bills.

Since October 1994, the Colorado WAP program has served between 120,000 to 140,000 households. Although this service level is impressive, it represents only 12 percent of eligible households in the state. CEO estimates that in 2014, more than 700,000 Colorado households were eligible for weatherization services (approximately 30 percent of the roughly 2 million total households in Colorado). Based on the current trajectory, CEO estimates that the number of eligible households could exceed 880,000 by 2040. Currently, CEO weatherizes approximately 2,000 to 3,000 households a year. If WAP program funding continues, CEO expects to serve 17 percent of all qualified homes by 2040. [xxxv]

Participating households must earn at or below 200 percent FPL or already receive financial assistance from any of the following programs:

- Temporary Assistance for Needy Families
- Aid to the Needy and Disabled
- Old Age Pension
- Supplemental Security Income
- Low-Income Energy Assistance Program
- Supplemental Nutrition Assistance Program
- Social Security Disability Insurance

[8] For more information visit: https://sites.google.com/a/state.co.us/cdhs-leap/

[9] For a full list of LEAP office locations by County see: https://sites.google.com/a/state.co.us/cdhs-leap/contact-leap

2.3.3.3 Property Tax, Rent, and Heat Rebate ("PTC" Rebate)

The Colorado State Department of Revenue allows tax rebates for home heating payments for residents of at least 65 years of age, surviving spouses at least 58 years old, and those with disabilities (regardless of age).[10] The income limit for a single household changes annually. In 2016, the PTC was available to households with a single person who earned less than $13,234 and married couples with a combined income below $17,839.[11] The rebate is based on the applicant's income and expenses. The maximum tax rebate is $660, and the maximum heat expense rebate is $192.

2.3.3.4 Department of Local Affairs Community Services Block Grant (CSBG)

The Community Services Block Grant (CSBG) is a federally funded program that provides formulaic grants to alleviate the causes and conditions of poverty in communities. Colorado has 31 eligible local entities working under nine CSBG federal objectives including employment, education, income management, housing, emergency services, nutrition, linkages with other programs, self-sufficiency, and health.[12]

CSBG grants are provided to eligible entities that are governor-appointed non-profits, public agencies, or a community action agency. The State Weatherization Office and LIHEAP are eligible entities.

2.3.3.5 Non-profit Resources

Energy Outreach Colorado (EOC), a Colorado 501(c)3 non-profit organization, raises energy assistance funding through individual, organizational, and governmental resources to help support low-income households. In 2015, EOC invested over $23 million to support affordable home energy programs throughout Colorado. Of that, $10.3 million went to energy bill payment assistance to over 22,500 households distributed through 107 partner's assistance organizations.[13] In addition, EOC provided additional funding to the LEAP program.[xxxvi]

In 2015, EOC funds helped weatherize 3,852 affordable housing units through CEO's WAP Program and EOC's Colorado's Affordable Residential Energy program (CARE). EOC provided over $2 million in energy efficiency improvements to 35 non-profit facilities through their Non-profit Energy Efficiency Program (NEEP). EOC also administers the Crisis Intervention Program (CIP), which provides emergency repair or replacement to home heating systems for income-qualified households through a network of licensed and certified HVAC contractors. Lastly, EOC provides Affordable Housing Efficiency Grants to multi-family affordable housing facilities through their Affordable Housing Energy Rebate Program and Affordable Housing Weatherization Program.

2.3.3.6 Additional Funding Sources

Colorado has 57 utilities, many of which are attempting to address the energy burden issue through their own programs and policies. Utilities can be especially effective at reaching low-income households, because they already have a built-in communication channel and relationship with households. Ratepayer-funded energy efficiency programs can account for a substantial portion of energy savings opportunities.

Utilities can adjust these energy efficiency programs to target low-income households by:

- making energy efficiency and renewable energy upgrades and rebates available at no or low cost to their low-income customers;
- providing higher financial incentives for low-income households;
- allocating a percentage of program to low-income households;
- targeting education campaigns to low-income households; and
- targeting renters and multi-family housing.

Utilities can also consider modified rate designs, rate discounts or waivers, and modified billing methods such as on-bill recovery (OBR) or on-bill financing (OBF), which allows customers and financial institutions to use their electric bill as a means of repaying an energy-related loan.

Several utilities have "Operation Round Up" Options (i.e. Black Hills Energy Cares Program and Yampa Valley Electric Association Operation Round Up), which allow customers to round up their monthly energy bill and donate the difference to those in need.

The PUC could potentially set low-income energy savings goals, carve-outs, and spending requirements for utilities to help increase investment in low-income energy efficiency programs.

[10] For more information visit: https://www.colorado.gov/pacific/tax/property-tax-rent-heat-credit-ptc-rebate-file

[11] Additional eligibility requirements can be found here: https://www.colorado.gov/pacific/tax/property-tax-rent-heat-credit-ptc-rebate-file and https://www.colorado.gov/pacific/sites/default/files/104PTC.pdf

[12] For more information including a list of eligible entities see: https://www.colorado.gov/pacific/dola/community-services-block-grant-csbg

[13] For a full list of the agencies by county, see: http://www.energyoutreach.org/get-help/find-local-agency/

2.4 Community Solar Overview

2.4.1 Overview of Solar Energy

Fueled by price reductions and a motivation to reduce greenhouse gas (GHG) emissions, the number of solar installations across the country is growing rapidly. According to Solar Energy Industry Association (SEIA), in 2016 almost 400 MW was installed for a current total of 925.8 MW.[xxxvii] Over the next five years, a SEIA study expects Colorado to install 1,878 MW of solar electricity capacity (twice as much as was installed between 2010 and 2016 nationwide). The huge increase in installations can mostly be attributed to the drastic price drop in solar photovoltaic (PV) systems (66 percent between 2010 and 2016) and innovative financing mechanisms.[xxxviii] See Figure 7.

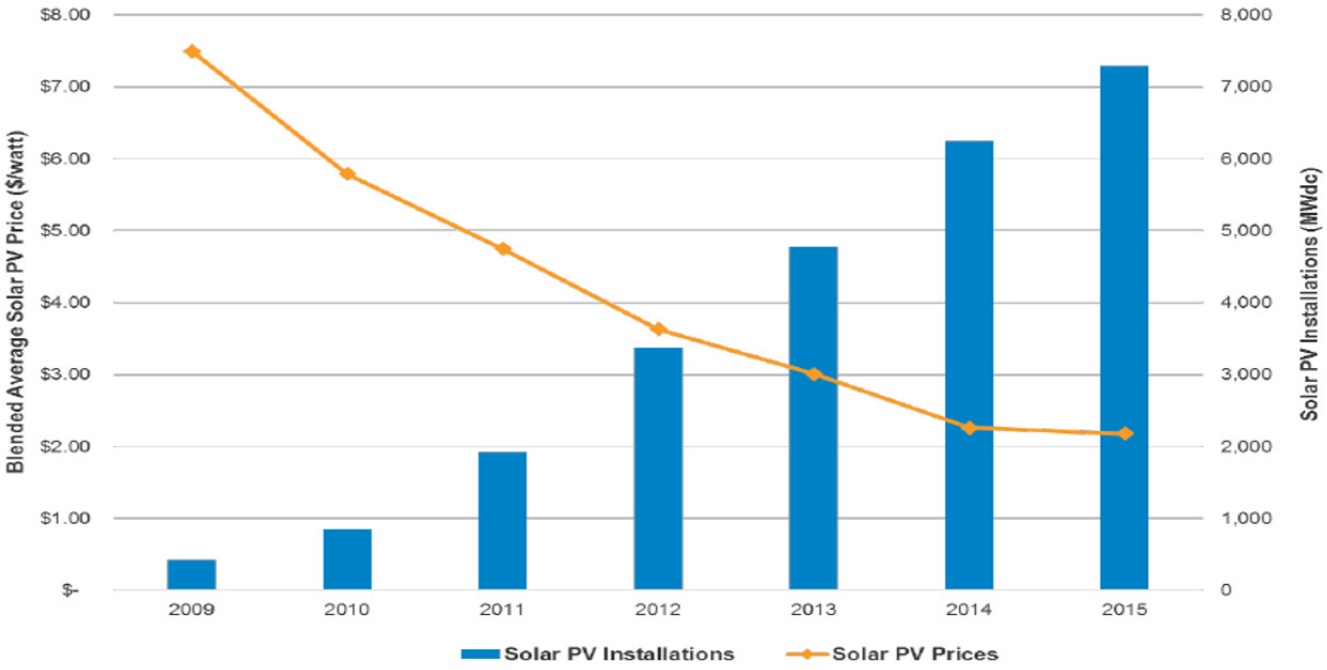

FIGURE 7: NATIONAL SOLAR INSTALLATIONS AND PRICES[xxxix]

Solar also has numerous environmental benefits such as reduced air pollution, reduced GHG emissions, reduced water pollution (compared to fossil fuels), reduced water use, and reduced need for finite resources (fossil fuels). As noted in the NAACP's *Just Energy Policy* report, solar energy can also help advance social and environmental justice issues.[xl] In addition, the solar industry can create a considerable number of jobs -- as much as three times that of the fossil fuel industry for comparable amounts of electricity.[xli]

According to a recent report from Lawrence Berkeley National Laboratory, electricity produced from utility-scale solar is cost competitive (or even less expensive) than electricity produced from natural gas.[xlii] Solar can provide the important benefit of stable energy prices, because once a facility is built, the fuel (sunlight) is free. Price stability is especially important for low-income households whose budgets are tight, making them less able to cope with the price fluctuations associated with fossil fuels.

Even with the reduced costs, myriad incentives, and procurement options, the benefits of solar PV remain largely out of reach for most low-income households. Even more problematic, low-income households pay into utility rebate and incentive pools, yet rarely, if ever, directly benefit from those instruments themselves. Across the country, there are 49.1 million households, representing 42 percent of all households nationally,[xliii] that earn less than $40,000 per year and account for less than 5 percent of solar installations.[xliv] See Figure 8.

2.4.2 Why Community Solar?

A community solar garden (also called shared solar, roofless solar, or solar gardens) is a large solar PV array made up of many individual panels. Private and public organizations, non-profit entities, utility companies, housing authorities, or private solar garden developers typically own the gardens. These organizations may use a certain number of panels to fulfill their own needs and/or may sell or lease individual or groups of panels to household or commercial subscribers. Community solar gardens are typically ground-mounted and, in ideal situations, are located on undesired land such as capped landfills. Community solar can be sited for optimized panel orientation and solar tracking, resulting in increased maximum production in comparison to rooftop systems.

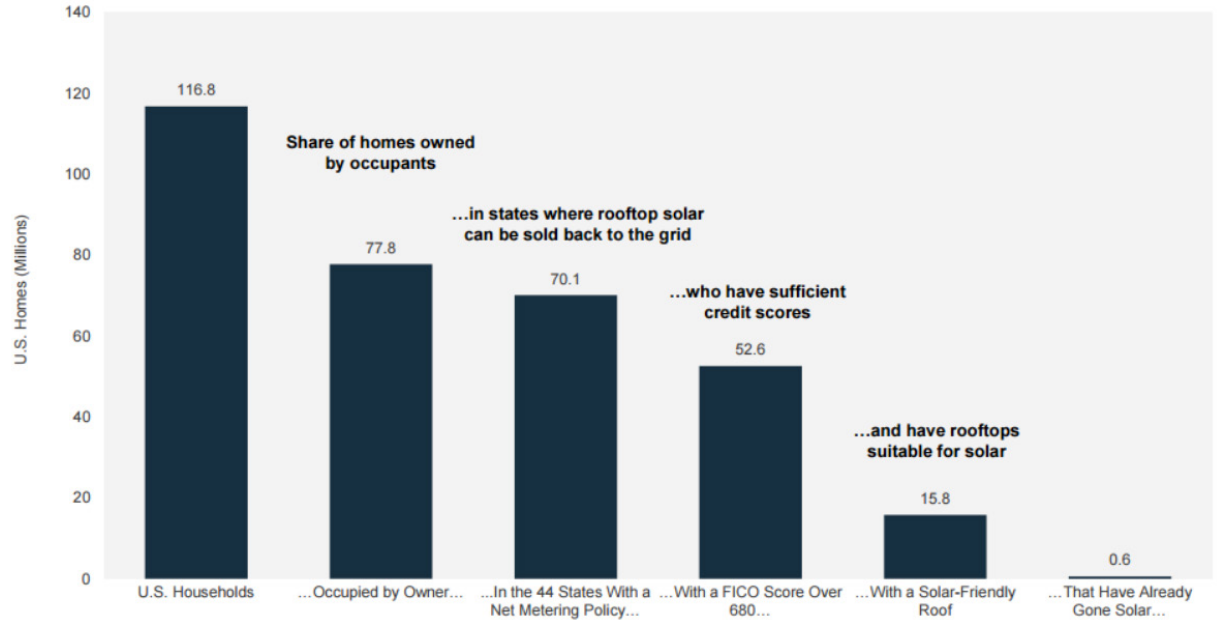

FIGURE 8: 2015 RESIDENTIAL CUSTOMER DEMOGRAPHICS BY ROOFTOP SOLAR CONSTRAINTS[XLV]

Typically, the community solar garden owner is responsible for all operation and maintenance activities and land management. The utility may allow the subscriber to transfer the panels to another subscriber if the subscriber moves outside the service territory, no longer wants solar energy, or needs a smaller system from improved energy efficiency. As with most solar energy systems, community solar costs escalate at fixed and known rates, which allows the subscriber to essentially "lock-in" electricity prices and hedge against utility rate price inflation.

Two common financial models for community solar include: 1) outright purchase of specific panels; and 2) purchase of the electrons generated by the panels, while the solar garden owner retains ownership of the specific panels. Under the former option, subscribers may see a payback period between eight and 15 years.[14] If the latter option is pursued, subscribers have no upfront capital costs, realize cost savings immediately, and only pay for the electricity generated by the system, but the subscriber will never own the assets. Some programs offer a hybrid of the two financial models. Most commonly, the utility issues a credit to the subscriber, which offsets the subscriber's utility costs, including costs for electricity consumption and flat recurring charges.

Although many low-income programs are designed to reduce energy burden, most of these programs focus on reducing home heating costs and energy consumption, and many energy efficiency programs designed to help low-income households are not reaching all low-income households: low-income households may not qualify, may be unaware of such programs, or may be unwilling to participate in such programs. Many programs are only available for the very low-income households, excluding those who are above the income threshold but are still struggling to make ends meet. Conversations with low-income advocates and energy-efficiency experts indicate that low-income households may have privacy concerns, may not be able to effectively communicate with program representatives, and may be skeptical of programs that are offered.

As a low-income energy program option, community solar offers a unique and flexible energy burden reduction opportunity for renters, which many other solar options cannot provide.

There is an additional barrier for renters who have less control over building or unit maintenance and upgrades. Since homeowners and landlords are not required to disclose energy costs, low-income residents may move into a new home completely unaware of high energy costs, particularly in winter months. This is especially common in colder climates, where monthly energy costs can exceed several hundred dollars.[15] Compounding this problem is the fact that many low-income households have less access to capital and are not well positioned to invest in energy efficiency home improvements and landlords may be dis-incentivized to overcome common split incentives barriers.

As a renewable energy resource, the structure of community solar gardens is well-suited to meet the unique needs of low-income subscribers. Community solar helps fill the gap in service offerings by:

- reducing remaining electricity costs;
- allowing for subscriber turnover as rental tenants change;

[14] Based on industry experience.

[15] Based on anecdotal evidence. Quantitative metrics and/or studies to support this claim could not be found.

- providing assistance to the household, regardless if they rent or own;
- focusing on cost reductions, not home improvements;
- providing cost reductions without a capital investment; and
- being available to low-income income brackets that are higher than most existing programs and policies.

Nearly two-thirds of the multi-family rental market consists of households with an annual income of less than $50,000, and community solar is an especially effective way to address the energy burden in the multi-family rental market. Many low-income households live in multi-family housing and/or rental units, and there is little incentive to invest in a solar system that may not be theirs within a few years. To date, community solar has been well-received across the country and is expected to grow rapidly in the near-term.

2.4.3 Community Solar in Colorado

In 2010, Colorado Governor Bill Ritter signed House Bill 10-1342 authorizing the creation of community solar gardens by IOUs to encourage additional investment in solar energy generation. In May 2015, House Bill 15-1377[16] was passed, which allows for co-operative utilities to utilize community solar gardens, and soon after, HB 15-1284[17] further developed how community solar gardens would function in Colorado. These groundbreaking laws have paved the way for Colorado to become a national leader in community solar. The basics of the bill are as follows:

- Applies only to IOUs
- Renewable Energy Credits (RECs) from the community solar gardens count towards the IOU's compliance with the Renewable Portfolio Standard [18]
- Solar gardens must be 2 megawatts (MW) or less
- Solar gardens must have at least 10 subscribers [19]
- Each subscription must be at least 1 kilowatt (kW) (low-income households are exempt from this requirement)
- Subscriptions cannot supply more "than 120 percent of the average annual consumption of electricity by each subscriber at the premises to which the subscription is attributed, with a deduction for… any existing solar facilities at such premises"
- The subscriber must live within the same county or the county adjacent to that of the community solar array [20]
- Utility companies must allocate at least 5 percent of each community solar garden to low-income subscribers (to the extent that there is demand for such ownership). [21]

In 2016, the Colorado PUC approved a sweeping settlement with Xcel Energy for more flexible electricity rates and additional solar energy. The settlement called for an additional 225 MW in rooftop solar, 117 MW in community solar gardens, and 60 MW in power generated from industrial waste heat over a three-year period. In addition, the settlement created solar energy programs for low-income households with up to 18 MW of capacity. This settlement was achieved, in part, due to CEO's and GRID's work on promoting the many benefits of community solar for low-income households. In addition, the CEO-funded report *Analysis of the Fulfillment of the Low-Income Carve-Out for Community Solar Subscriber Organizations*[22] helped provide a list of best practices on how to improve upon the current IOU community solar garden structure. CEO's continued work on community solar will ensure that low-income households are included in policy and programmatic conversations regarding solar moving forward.

Data from the Community Solar Hub (a joint project between Colorado's Community Energy Collective and the Department of Energy) shows that as of 2016 Colorado has nearly 33 MW of community solar, approximately 18.2 MW of which is located within IOU service territory. Approximately 0.9 MW of the total community solar is allocated to low-income households.

Through the Xcel Energy Settlement alone, an additional 117 MW of community solar will be put online in Colorado over the next three years -- almost four times the current capacity. Approximately 15 percent of the new Xcel Energy community solar capacity

[16] For more information, please see: http://www.leg.state.co.us/clics/clics2015a/csl.nsf/billcontainers/7D2B561E0A83252487257D9000776DB8/$FILE/1135_01.pdf

[17] For more information, please see: https://leg.colorado.gov/sites/default/files/images/olls/2015a_sl_170.pdf

[18] RECs generated from the community solar gardens cannot be used to achieve more than 20% of the retail renewable distribute generations requirements.

[19] Pursuant to PUC regulations, no subscriber can own more than a 40% interest "in the beneficial use of the electricity generated by the CSG, including without limitation, the renewable energy and RECs associated with or attributable to the CSG.

[20] "Prior to the passing of House Bill 15-1284, the subscriber was required to be "within either the same municipality or the same county as the community solar garden; except that, if the subscriber lives in a county with a population of less than twenty thousand, according to the most recent available census figures, such physical locations may be in another county, also with a population of less than twenty thousand, within the service territory of the same qualifying retail utility and also adjacent to, that of the community solar garden. However, House Bill 15-1284 simplified the requirement by saying the subscriber could be located in the same or adjacent county as the community solar garden. For more information see: http://www.leg.state.co.us/clics/clics2015a/csl.nsf/fsbillcont/76F3BB1F2F-8DA5A987257DFF00691ACE?Open&file=1284_enr.pdf

[21] It should be noted that the 5% carve-out was not included in House Bill 10-1342 but instead in the PUC rule making.

[22] For more information, please see: https://www.colorado.gov/pacific/sites/default/files/atoms/files/Low-Income%20Community%20Solar%20Report-CEO.pdf

will be allocated towards low-income households leading to a ten-fold increase in the amount of community solar allocated to low-income households in Colorado.

Utility Company	Facility Name	Capacity (kW)
Black Hills Energy	Community Solar Garden	Pending
Black Hills Energy	BHE Roofing	125
City of Fort Collins	Low-Income CEO sponsored demonstration project	65
Colorado Springs Utilities	Colorado Springs Community Solar Array	497
Community Energy Solar	Lafayette	1,000
Delta Montrose Electric Association	Read Facility Location	10
Delta Montrose Electric Association	The Community Solar Array Program	20
Delta Montrose Electric Association	Low-Income CEO sponsored demonstration project	151
Ecoplexus	Logan	1,997
Ecoplexus	Mesa	1,997
Empire Electric Association	Solar Assist Cooperative Garden	10
Empire Electric Association	Low-Income CEO sponsored demonstration project	21
Fort Collins Utilities	Fort Collins Utilities Solar Array 1	621
Grand Valley Power	Solar Farm	29
Grand Valley Power	Low-Income CEO sponsored demonstration project	36
Holy Cross Energy	Mid Valley Solar Array	78
Holy Cross Energy	Low-Income CEO sponsored demonstration project	145
Holy Cross Energy	Community Solar Array 4	826
Holy Cross Energy	Garfield County Airport Solar Array	858
Holy Cross Energy	Sunnyside Ranch Community Solar Array	1,793
La Plata Electric Association	La Plata Electric Association	1,025
Poudre Vally Rural Electric Association	PVREA Headquarters Solar Array	116
Poudre Vally Rural Electric Association	PVREA Solar Array 2	632
Poudre Vally Rural Electric Association	Low-Income CEO sponsored demonstration project	700
San Miguel Power Association	Low-Income CEO sponsored demonstration project	197
San Miguel Power Association	Paradox Valley Solar Array	1,124
SunShare (CSU)	Good Shepherd Solar Garden	500
SunShare (CSU)	Pikes Peak Solar Garden + Colorado Springs Solar Gardens	3,200
SunShare (Xcel)	Arapahoe Solar Garden	500
SunShare (Xcel)	Denver Solar Garden	1,000
SunShare (Xcel)	Jefferson	1,500
SunShare (Xcel)	Adams Imboden Solar Garden	4,000
SunShare CSU	Venetucci Farm	576
United Power	Sol Partners Program	21
Xcel Energy	Demo 3	1,000
Xcel Energy	Jefferson County 1	115
Xcel Energy	Denver/Lowry Community Solar Array	400
Xcel Energy	Boulder Cowdery Meadows Solar Array	496
Xcel Energy	Denver County 3	497
Xcel Energy	Breckenridge Ullr Solar Array	498
Xcel Energy	Aurora/Arapahoe Community Solar Array	498
Xcel Energy	Denver County 2	499
Xcel Energy	Breckenridge Sol Array	500
Xcel Energy	Aurora/Arapahoe Community Solar Array 2	500
Xcel Energy	Boulder County Community Solar Array 2	500
Xcel Energy	Lake County Community Solar Array	500
Xcel Energy	Jefferson County 2	569
Yampa Valley Electric Association	Low-Income CEO sponsored demonstration project	148
Yampa Valley Electric Association	Yampa Valley Community Solar Array	579
Total		32,669

TABLE 6: COLORADO COMMUNITY SOLAR PROJECTS[XLV]

3. Project Evaluation

3.1 Demonstration Project's Community Solar Framework

While each utility designed and implemented variations of a low-income community solar model, all projects followed the same framework based on GRID's process as highlighted below.

GRID and CEO approached co-operative and municipal electric utilities across the state to gauge interest and commitment. Interested utilities, alongside GRID, then pitched the project to their respective Board of Directors, and if approval was received, they began the design phase with GRID. At the project's onset, GRID negotiated the program design with each utility and outlined the project requirements, goals, and general roles and responsibilities in a Memorandum of Understanding (MOU).

Each project was implemented using a turn-key installation in a "barn-raising" community development model, where subscribers were encouraged to donate 16 hours of sweat equity by working alongside GRID, the utility, and community partners to build the arrays. Oftentimes, utilities were able to build the array adjacent to their headquarters and avoid extraneous trenching and other complications; however, sometimes arrays were constructed off-site. Arrays that were installed on utility-owned land were exempt from additional permitting from the State Electrical Board.

All the utilities participating in the Demonstration Project were distribution utilities and purchased their electricity from a wholesale provider. Upon becoming a member of the Demonstration Project, each utility had to consider the contractual limitations as dictated by their wholesale provider.

Colorado's Renewable Portfolio Standard[23] requires that all utilities in the state, including wholesale electricity providers and co-operative and municipal utilities, acquire a portion of their electricity from renewable energy sources; thus, motivating the accumulation of RECs. Many of the co-operative and municipal utilities kept the RECs, while the remaining utilities sold the RECs to their wholesale providers. This was mainly determined by a co-operative's or municipality's wholesale provider contractual agreement and/or was based on the internal goals of the co-operative or municipal utility.

Since all arrays are less than 80 MW they are all qualifying facilities (QF) under Public Utilities Regulatory Act (PURPA). PURPA requires that co-operative and municipal electric utilities must purchase renewable, hydrogenation and/or waste electricity from QFs in their service territory.[24] However, co-operative and municipal electric utilities must also adhere to their contractual requirements with their wholesale electric providers.

At times, a wholesaler provider's contractual requirements may be at odds with PURPA. This occurred for utilities that were members of Tri-State Generation and Transmission (Tri-State). Tri-State's contract states that no more than 5 percent of a member-owned utility's load may be sourced from renewable energy. Yet, this is in contradiction with PURPA, which states that a utility must purchase renewable energy from a QF regardless of the utility's existing energy load or energy mix. The difference in interpretation was settled in court and the Federal Energy Regulatory Commission (FERC) ruled in favor of PURPA. Tri-State then responded by developing a new recovery fee that would be charged to its member utilities that pursued renewable energy generation in excess of the 5 percent distributed generation limit. The legality of this fee is currently being contested with FERC. To date, all the Demonstration Project partners are in compliance with their wholesale provider's electricity contracts regardless of FERC's previous ruling.[25]

Capital costs were covered by the CEO grant, internal funding from the utility, and/or financing acquired by the utility. The largest

[23] For more information visit: https://www.colorado.gov/pacific/energyoffice/renewable-energy-standard.

[24] For more information see: https://www.ferc.gov/industries/electric/gen-info/qual-fac/what-is.asp

[25] Content related to PURPA came from conversations with co-operatives, municipalities, and Scott Dunbar (attorney at Keyes & Fox, LLP)

project was with PVREA, and they reached economics of scale necessary to bring in third-party financing and tax equity. GRID was required to leverage CEO grant funds with a two-to-one investment for each project, which was usually covered by the utility in direct financing and in-kind support. Typically, this investment was taken from an existing fund, which would be paid back over time with the accrual of the subscriber's solar payment. Operation and maintenance activities were typically conducted in-house, by utility staff, but a few utilities opted to pay GRID a nominal fee for annual services.

Subscribers were solicited through traditional outreach and marketing methods executed in tandem by GRID and the utility. These methods included flyers, brochures, direct calls, and in-person workshops. Households that had previously received weatherization services were targeted for outreach to ensure those subscribed maximized energy cost savings.

Many utilities designed the project so that the community solar system would offset 100 percent of a subscriber's usage, resulting in a cost savings of approximately 50 percent, while other utilities designed their projects so that a subscriber's usage would be offset by a pre-determined kW cap and cost savings were more influenced by usage.

Subscribers were charged for the regular electricity consumed (i.e. the retail electric rate) plus fixed monthly fees. The utility would then issue a bill credit (i.e. a credit on the utility bill, not to be confused with an actual check) for the solar electricity generated by the panels allocated to the subscriber's household. The subscriber would be responsible for the difference in payment. Many utilities referred to the difference in retail electric rates and the bill credit as the "solar payment".

During the course of the 20-year community solar contract (sometimes 25 years), utilities will receive two sources of revenue from the subscriber: the solar payment and monthly fixed charges. Tri-State utilities (Empire Electric Association, Delta-Montrose Electric Association, San Miguel Power Association) will also receive the wholesaler provider's bill credit. If the utility was selling the RECs to the wholesale provider, they would receive revenue from the RECs. Some utilities would then pay the wholesale provider for the electricity consumed by their subscribers at the original wholesale rate.

The primary goal of each demonstration model was to provide the utmost benefit and value to the utility's low-income customers, while maximizing the effectiveness of the utility's and CEO's financial contributions.

3.2 Overview of Each Model

CEO and GRID partnered with eight rural co-operative and municipal electric utilities to develop community solar garden demonstration models:

1. Empire Electric Association
2. Delta-Montrose Electric Association
3. City of Fort Collins Electric Utility
4. Grand Valley Power
5. Holy Cross Energy
6. Poudre Valley Rural Electric Association
7. San Miguel Power Association
8. Yampa Valley Electric Association

For high-level project statistics refer to Table 7. For a detailed analysis of each project refer to *Appendix A: Model Case Studies.*

Utility	Project Size (kW)	Number of Households	Project Cost	Projected Percent Cost Savings	Project Completion (# Months)	2017 Bill Credit Rate ($/kWh)	2017 Solar Payment Rate ($/kWh)
Delta-Montrose Electric Association	151	43	$315,900	50%	12	$0.065	$0.040
Empire Electric Association	26	7	$78,750	50%	6	$0.072	$0.024
Fort Collins Utilities	64	30	$195,000	50%	15	$0.076	$0.021
Grand Valley Power	37	10	$55,250	50%	10	$0.102	$0.020
Holy Cross Energy	145	45	$400,099	15 to 50%	17	$0.079	$0.021
Poudre Valley Rural Electric Authority	700	140	$1,375,000	30%	20	$0.028	$0.066
San Miguel Power Association	197	60	$465,000	50% of 2 kW	19	$0.053	$0.082
Yampa Valley Electric Authority	165	45	$333,416	50%	12	$0.053	$0.030

TABLE 7: DEMONSTRATION MODEL STATISTICS

3.2.1 Delta-Montrose Electric Association (DMEA)

DMEA is a rural electric co-operative utility serving 12,000 members in Montrose, Delta, and Gunnison counties. DMEA's primary project goals were to develop local energy resources, increase energy independence, and expand services to low-income households.

DMEA installed the community solar array adjacent to DMEA's headquarters on land owned by DMEA. DMEA purchases electricity from Tri-State, and this project was subject to Tri-State's Board of Director's Renewable Energy Policies 115 and 117. Policy 115 outlines the bill credits paid to DMEA by Tri-State and places a cap on member-owned generation of no more than 5 percent. Policy 117 outlines the REC payments paid to DMEA by Tri-State. It should be noted that DMEA was required to pay Tri-State for the electricity consumed by its members, even though this electricity was offset by the community solar garden array.

Outreach and marketing was conducted through two in-person workshops and distributed brochures. Subscribers were slightly hesitant due a reported lack of transparency with the funding streams, but ultimately the garden was fully subscribed and both DMEA and subscribers reported a very successful outreach effort. Subscriptions last five years and can be renewed.

DMEA SUBSCRIBERS: STEVE AND SUE SIDEBOTTOM

The total project duration (from initial conversation to subscriber cost savings) was approximately one year.

This project was unique because:

- When built in 2016, DMEA's low-income community solar garden was the largest of its kind in the country.
- DMEA's Board of Directors was motivated to create a local and resilient energy source for low-income members. In particular, "local" was a predominant driving force in garnering the Board of Director's support.

Since DMEA's renewable energy growth is restricted by Tri-State's 5 percent co-operative-owned generation cap, and they are operating the community solar project at a loss, DMEA is not sure if they can or will pursue additional community solar projects. However, they are open to additional projects if the economics are favorable and the project could be exempt from Tri-State's generation cap.

3.2.2 Empire Electric Association (EEA)

EEA is a rural electric co-operative utility serving 12,000 members in Montezuma, Dolores, and San Miguel Counties. EEA's primary project goals were to leverage CEO's Demonstration Project grant while providing expanded services to low-income households and reducing energy costs.

EEA installed the array adjacent to EEA's headquarters and next to an existing community solar garden, which was later integrated into EEA's demonstration model project. EEA purchases electricity from Tri-State. Due to its small size (i.e. 26 kW) EEA installed the community solar garden "behind-the-meter"[26] . Because the project was installed behind-the-meter it did not have to go through Tri-State's Renewable Energy Policies. This project was exempt from Tri-State's member-owned generation cap, and there was no financial transaction with Tri-State -- EEA retained ownership of the RECs and did not receive bill credits from Tri-State.

EEA SUBSCRIBER: LLYOD GALLION

Outreach and marketing was conducted through two in-person workshops. While many subscribers were hesitant at first, both EEA and subscribers reported successful outreach. Subscriptions last five years and can be renewed.

The total project duration (from initial conversation to subscriber cost savings) was approximately six months.

[26] 'Behind-the-meter' means that the solar production meter was installed on the customer's side of the meter.

This project was unique because:

- EEA leveraged a stranded asset. EEA had an existing 10 kW community solar garden that was not fully subscribed, and EEA integrated 5 kW from the existing garden with the new low-income community solar garden.
- CEO's grant helped build a renewable energy resource in a region where very few resources existed before.

Unless another grant becomes available, EEA has no plans to pursue another low-income community solar garden. While EEA believes that many of its members support renewable energy, a new renewable energy system could increase electricity costs, and they do not believe that their members are willing to pay for it.

3.2.3 City of Fort Collins Electric Utility

Fort Collins Utilities is a municipal electric utility serving 70,500 homes in Larimer County. Fort Collins Utilities' primary project goals were to integrate the community solar garden with energy conservation efforts and help ensure the permanent reduction of utility costs.

The array was installed on a warehouse building owned by the City of Fort Collins. The City of Fort Collins Electric Utility purchases electricity from Platte River Power Authority (PRPA). PRPA's renewable energy policies prevent the City of Fort Collins from offsetting more than 1 percent of their peak demand from renewable energy sources if the system is not owned by PRPA households. Since the array is owned by PRPA households and Fort Collins Utilities has not hit their 1 percent cap, the array was exempt from this limitation.

Outreach and marketing was conducted by reaching out to over 200 LEAP households to those households that use electric heat. Final selections were made using a raffle. Subscriptions last one year and are not renewed.

The total project duration (from initial conversation to subscriber cost savings) was approximately 15 months.

This project was unique because:

- Fort Collins Utilities mandates that community solar participants also partake in energy efficiency upgrades and education to ensure that energy savings are permanent.
- Subscribers will only be able to receive benefits for one year to ensure that the maximum number of different household's benefit from community solar within the 25-year timeline.
- The system was installed on a rooftop instead of ground-mounted.
- All subscribers were currently receiving LEAP benefits to help pay for their electric heat costs.

Fort Collins Utilities will continue to explore community solar options to meet its ambitious greenhouse gas emission reduction goals and to further decrease costs for its customers.

3.2.4 Grand Valley Power (GVP)

GVP is a co-operative electric utility serving 18,000 meters in Mesa, Delta, and Garfield Counties. The project was the fifth installment of a larger community solar array that was first implemented in 2011. Each installment or "phase" was so successful that GVP continued to build more capacity. GVP's primary project goals were to continue to grow their existing low-income community solar offerings and to continue to expand services to low-income co-operative members.

GVP purchases electricity from Xcel Energy. Xcel Energy did not require GVP to work through Xcel Energy to develop or build the array. The panels were installed on land owned by GVP, and the community solar production meter was interconnected to GVP's electric grid. GVP's income qualified community solar garden was exempt from the State Electrical Board's regulations on solar generation; therefore, no state electrical permit was required.

The success of GVP's previous community solar array phases helped build interest for new subscribers of Phase 5. Word of mouth within the community spread quickly, and many of GVP's members sought out subscriptions. Since the Housing Resources of Western Colorado (HRWC) provided a NeighborWorks grant to support the project, they claimed priority enrollment for their clients. HRWC will refer all their eligible clients to GVP and GRID for subscriptions. GRID sent out mailers to households that had been previously weatherized, and they reached out to subscribers that were on the waitlist from previous phases.

The total project duration (from initial conversation to subscriber cost savings) was approximately ten months.

This project was unique because:

- GVP built the first low-income community solar garden in the country in 2015.
- This was the fifth phase of a larger community array.
- GVP invited the local weatherization administrator to be part of the project and allowed their clients priority enrollment

The community solar site is now at capacity and; therefore, GVP has no plans to build additional community solar arrays. GVP continues to advocate for low-income community solar and recently met with policy makers in Washington D.C. to propose community solar funding support through the national Community Development Block Grants.

3.2.5 Holy Cross Energy (HCE)

HCE is a rural electric co-operative utility serving 56,000 meters located in the counties of Eagle, Garfield, Gunnison, Mesa, and Pitkin Counties. HCE's primary project goals were to increase the amount of renewable energy on its grid and reduce energy costs for qualifying members.

HCE installed the community solar array adjacent to a warehouse building on land owned by HCE. HCE purchases electricity from Xcel Energy. Xcel Energy did not require HCE to work through Xcel Energy to develop or build the array.

Outreach and marketing was conducted using program brochures, radio ads, promotion on HCE's website, and direct outreach to members. HCE and GRID also co-hosted five informational workshops for subscribers in different areas of HCE's service territory. HCE reported successful outreach, but noted that many subscribers had difficulty completing the paperwork. In-person outreach was most useful to help people complete the application process. Subscriptions are limited to 5 kW, last two years, and can be renewed.

The total project duration (from initial conversation to subscriber cost savings) was approximately 17 months.

HCE SUBSCRIBERS: THE CASTILLA FAMILY

This project was unique because:

- The project is part of Holy Cross Energy's larger renewable energy strategy, which aims to increase the amount of solar on its grid by 40 percent by 2025.
- Subscribers receive project benefits on two-year terms.
- Holy Cross Energy will work with GRID Alternatives, CEO's weatherization assistance program, and local partners to ensure that clients receive energy efficiency education and services.

The community solar project is part of HCE's larger renewable energy strategy, and they will continue to pursue community solar gardens as necessary.

3.2.6 Poudre Valley Rural Electric Association (PVREA)

PVREA is an electric co-operative utility that provides services for over 40,000 residences and businesses in Larimer, Boulder, and Weld Counties in Northern Colorado. PVREA's primary project goal was to create a "PV for All Program," which will provide solar benefits to 140 low-income households and increase the amount of renewable energy on their grid.

PVREA partnered with the CEO and GRID to develop the 1.95-megawatt (MW) Coyote Ridge Community Solar Array that will serve low-income households, non-profits, and interested PVREA members. The low-income allocation of the array is 700 kW, the non-profit allocation is 500 kW, and the traditional community solar array open to all PVREA subscribers is 750 kW. The panels were installed on land leased from Larimer County that was used to support landfill operations.

PVREA promoted the program on their website, and together with GRID, led subscriber outreach through bill stuffers and informational workshops.

This project was unique because:

- The 1.95 MW system is the largest solar project completed as part of the Demonstration Project.
- The energy output will benefit not only low-income households, but also affordable housing providers, nonprofit organizations, and all interested PVREA members.
- The project utilizes the Investment Tax Credit and Modified Accelerated Cost Recovery System.
- The project is sited on approximately 9 acres of land south of the Larimer County Landfill.

Moving forward PVREA will continually monitor the program to see if there are ways to improve the program and continue to explore future cost-effective solar projects and renewable options.

3.2.7 San Miguel Power Association (SMPA)

SMPA is a rural electric co-operative utility serving 13,400 meters in Ouray, San Juan, San Miguel, Montrose, Mesa, Hinsdale, and Dolores Counties. SMPA's primary project goals were to provide renewable energy to low-income households.

SMPA installed the community solar array approximately 45 minutes away from SMPA's headquarters on a retired landfill -- turning a brownfield into a "brightfield". SMPA purchases electricity from Tri-State, and this project was subject to Tri-State's Board of Director's Renewable Energy Policy 115. Policy 115 outlines the bill credits paid to SMPA by Tri-State and places a cap on member-owned generation of no more than 5 percent. It should be noted that SMPA was required to pay Tri-State for the electricity consumed by its members, even though this electricity was offset by the community solar garden array. SMPA choose to retain the RECs, and therefore, did not pursue Tri-State's Policy 117. SMPA sells the RECs to local organizations and uses the generated revenue to pay for energy efficiency and renewable projects.

SMPA SUBSCRIBERS: THE NELSON FAMILY

SMPA administers an income-qualified energy efficiency rebate program called IQ (income-qualified) weatherization. SMPA called each IQ weatherization program participant and encouraged their household's participation in the "follow-up" income-qualified community solar program. Participants in the community solar program had to either have gone through the IQ Weatherization Program or CEO's WAP. GRID assisted with outreach and marketing by sending out postcards and calling prospective subscribers. SMPA reported successful, but labor intensive, outreach. Subscriptions are limited to 2 kW, last five years, and can be renewed.

The total project duration (from initial conversation to subscriber cost savings) was approximately 19 months.

This project was unique because:

- SMPA integrated its low-income community solar garden with its income-qualified weatherization program.
- A portion of SMPA's low-income community solar garden was funded by SMPA's Green Fund -- a fund supported by Renewable Energy Credit (REC) purchases.
- SMPA's low-income community solar garden was constructed on an old landfill, transforming a brownfield to a "brightfield".

SMPA is working with Tri-State and other member co-operatives to develop more community solar and provide as many energy efficiency and renewable energy options to its members as possible.

3.2.8 Yampa Valley Electric Association (YVEA)

YVEA is a rural electric co-operative utility serving over 19,900 residents and businesses located in Eagle, Grand, Routt, and Moffat counties. YVEA's primary project goals were to reduce costs for low-income households and increase the amount of renewable energy on YVEA's grid.

YVEA installed the community solar array on its property and interconnected directly with YVEA's grid. YVEA purchases electricity from Xcel Energy. Xcel Energy did not require YVEA to work through Xcel Energy to develop or build the array.

Outreach and marketing was conducted using program brochures, mailers, promotion on YVEA's website, and direct outreach to members. YVEA and GRID also co-hosted several informational workshops. Subscribers were asked to bring income statements and tax returns with them so that they could be signed up immediately at the workshop. GRID also made several direct calls to households that had previously participated in CEO's weatherization program. Subscriptions are limited to 5.3 kW, last five years, and can be renewed.

HCE SUBSCRIBER: JULIE CAREY

The total project duration (from initial conversation to utility cost savings) was approximately 12 months.

This project was unique because:

- The project supports YVEA's goal to produce more electricity locally.
- Subscribers are capped at 5.3 kW due to the small size of the system, which will allow for an average project subscriber cost savings of 42 percent.
- YVEA will work with GRID, CEO's weatherization assistance program and local partners to ensure that clients receive energy efficiency education and services.

If this project proves itself to be successful, YVEA would be interested in creating another low-income community solar project.

3.3 Overview of Entire Demonstration Project

3.3.1 Regions Served

The eight demonstration models served 19 Colorado counties, mainly in Colorado's Mountain and Western Slope Regions, see Figure 9.

3.3.2 Timeline to Completion

On average, projects took approximately 14.5 months from introduction to completion. The process began when CEO and GRID introduced the project to the utility, and the process was considered complete when the garden was subscribed and subscribers saw cost savings benefits. The shortest timeline was six months, while the longest timeline was 19 months. Refer to Figure 10. Lengthy project timelines were influenced by a variety of factors including: delays from acquiring special permits for landfill development, delay in equipment delivery, and the utility's desire to postpone certain milestones to ensure alignment with other utility programs.

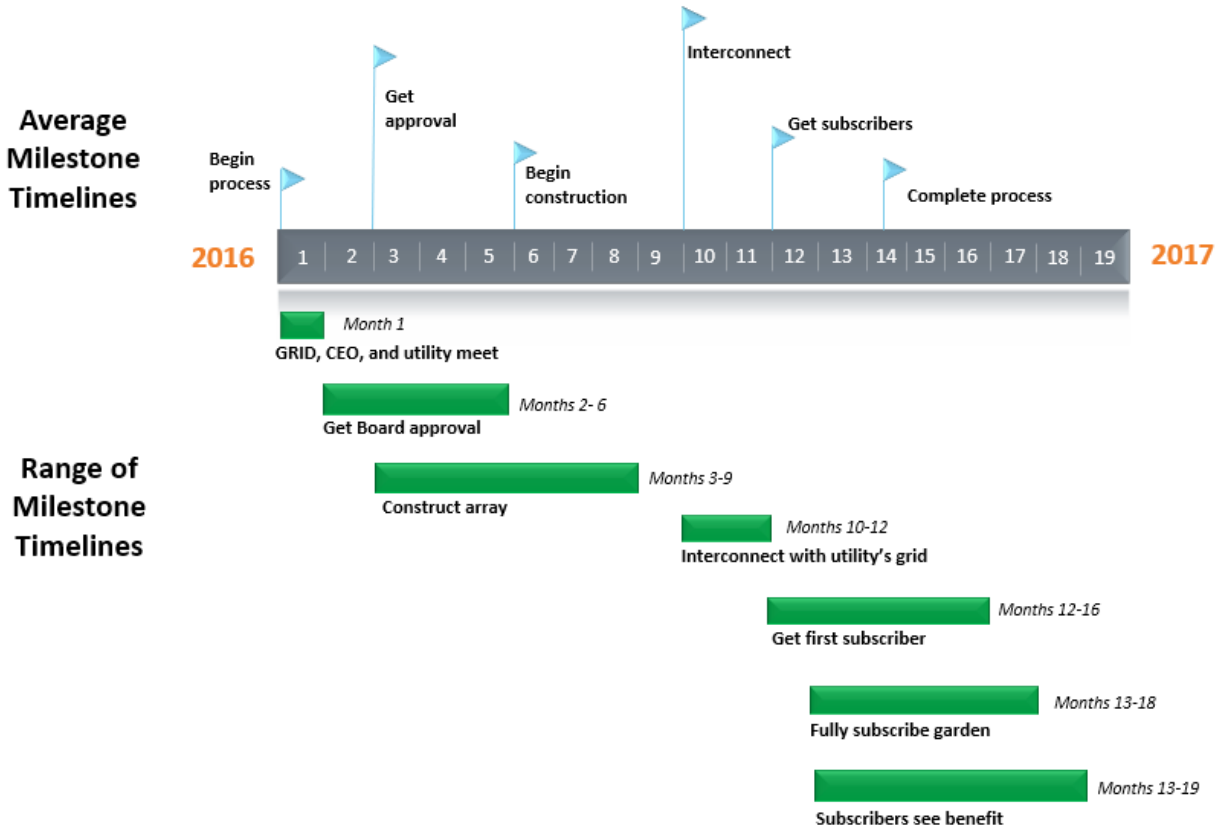

FIGURE 9: TIMELINE RANGE FOR EACH MAJOR PROJECT MILESTONE

3.3.3 Summary of Project Goals

Each utility was motivated by the unique needs of its members, its region, and its Board. There were 11 primary project goals. The following goals are listed in order of how often they were cited by the utility.

1) Provide benefit to low-income members
2) Provide a local, resilient electricity source and provide renewable energy and diversify energy supply
3) Reduce members' energy costs and provide locked-in, predictable energy prices
4) Enable utility staff to get hands-on experience with solar
5) Repurpose a brownfield
6) Support utility's mission and ratepayer's values of renewable energy and energy justice
7) Reduce members' electricity costs for households with electric heat
8) Leverage financial investment from CEO

The list above suggests that most demonstration models were driven by a strong desire to help reduce costs for low-income households and to bring more renewable energy to utility members. This was also echoed in several utility discussions, in which utilities noted that, until this project was available, co-operative and municipal utilities were limited in solar procurement options. Many solar projects were only available in coordination with private developers, and many utilities had a member-owned generation cap (i.e. renewable energy projects) mandated by wholesale providers.

"This project is a win-win, it helps Holy Cross members who are having a hard time making ends meet and adds more renewable energy to our power supply mix."

– Del Worley, former HCE CEO

The Demonstration Project provided another option to develop renewable energy sources and diversify the local utility's electricity supply. As one utility noted, the ability to have an electricity source that was locally generated in the region directly aligned with the fiercely independent nature of the region's residents.

3.3.4 Key Project Data

The cumulative impact of the Demonstration Project is shown in Table 8.

Utility	Project Size (kW)	Project Production (kWh)	# of Subscribers	Average Subscription Size (kW)	Average Annual Cost Savings per Subscriber	Targeted Cost Savings as Percentage of Utility Bill
Delta-Montrose Electric Association	151	243,128	43	3.6	$312	50%
Empire Electric Association	26	37,499	7	3.7	$485	50%
Fort Collins Utilities	65	87,181	30	3.2	TBD	50%
Grand Valley Power	37	56,336	10	3.2	$590	50%
Holy Cross Energy	145	228,147	45	3.3	$411	15 to 50%
Poudre Valley REA	700	1,250,000	140	5.0	TBD	30%
San Miguel Power Association	197	315,735	60	2.0	$134	50% of 2 kW
Yampa Valley Electric Authority	165	198.612	45	5.2	$360	50%
Total	1,486	2,416,638	380	-	-	-
Average	186	302,080	48	3.5	$382	-

Note: Only 125 kW of SMPA's capacity was originally intended for the Demonstration Project. In partnership with GRID, SMPA built an additional 72 kW of capacity in case there is additional demand from the community.

TABLE 8: KEY PROJECT DATA OF EACH SOLAR INSTALLATION

Colorado has approximately 33 MW of community solar. Prior to the projects, Colorado had less than 1 MW of low-income dedicated community solar. The eight solar garden projects put an additional capacity of approximately 1.5 low-income MW on Colorado's electric grids. This represents an increase of approximately 5 percent.

Approximately $3,218,415 was invested into the eight solar garden installations, including $1,200,000 invested by CEO and $2,018,415 invested by utilities. The CEO's investment will have a savings-to-investment (SIR) ratio of 1 to 3.68. With a capacity of 1,486 kW this total investment resulted in an average incremental cost of $2.15 per watt.

There were 380 subscribers served by the eight solar garden installations. Assuming an average annual cost savings of $382, the solar garden projects are expected to save Colorado low-income households approximately $145,160 annually. When combined with an approximate annual WAP savings of $200 per household, low-income households could save up to up $582 annually, and cumulatively, all Demonstration Project subscribers could save $221,160 annually. For a total, one-time investment of approximately $3,198,415, the Demonstration Project will save approximately $4,423,200 over 20 to 25 years .

Assuming an average energy burden of 7.2 percent (based on ACEEE's national average estimate, see Table 3), the Demonstration Project reduced subscriber energy burden by just over 1 percent for a new energy burden of 6.1 percent. When combined with cost savings from WAP, subscribers saw energy burden decrease by approximately 1.7 percent for a new energy burden of 5.5 percent. While CEO categorizes any subscriber's energy burden above 4 percent as "stressed," the Demonstration Project when combined with WAP, reduce a subscriber's energy burden to levels more consistent with those advocated by environmental justice experts (see *National Energy Burden*[27]) -- less than 6 percent.

Average annual salary: $2,400 / $33,333 = 7.2 percent

Demonstration Project impact: ($2,400 - $382) / $33,333 = 6.1 percent

Demonstration Project + WAP impact: ($2,400 - $382 - $200) / $33,333 = 5.5 percent

The calculations above used the following assumptions:

- Average energy burden of 7.2 percent (based on ACEEE's national average estimate, see Table 3)
- Average annual electricity cost of $1,250 (see *Delta-Montrose Electric Association case study*)
- Electricity and natural gas costs are approximately equal (see *Project Background and Objectives*)
- Average annual cost savings of $382 (see Table 8) from Demonstration Project
- Average annual cost savings of $582 (see Table 8) from Demonstration Project and WAP

[27] For more information, please see: http://energyefficiencyforall.org/sites/default/files/Lifting%20the%20High%20Energy%20Burden_0.pdf

3.4 Participation Drivers

3.4.1 Utility Drivers

3.4.1.1 Reasons Why Utilities Participated in the Demonstration Project

Utilities provided a diverse list of reasons as to why they decided to participate in CEO Demonstration Project.

Increase Solar Accessibility and Diversify the Grid's Electricity Generation Mix

- Renewable energy regulations: Several utilities are utilizing community solar to help them meet their distributed generation requirements as mandated in Colorado's RPS. In addition, Senate Bill 15-046[28] allowed community solar to count towards Retail Distribution Generation requirements under the state RPS.
- Renewable energy goals: Utilities want to increase the amount of renewable energy on their grid to meet internal renewable energy or greenhouse gas reduction goals.
- Community demand: Subscribers were requesting, even demanding, an increase in renewable energy produced locally.
- Energy independence: Board members expressed a strong drive for "energy independence" meaning that they would like to produce as much electricity locally as possible. Solar provides a great local, visible resource.

Access and Educate a New Market

- Provide solar to the low-income market: Many utilities expressed their concern that solar has historically been an asset for only middle- to upper-income households. This program allowed utilities to allocate solar to dozens (sometimes hundreds) of low-income households.
- High electricity users: Many utilities allocated solar to households that consumed a higher amount of electricity than normal. Many of these households are the most in need for electricity cost reductions.
- Reduced late or non-payments: One utility mentioned that they hope this program will reduce the number of low-income households that are late or end up not paying for their utility bills due to two reasons: 1) lower bills would lead to more households being able to afford their bills, and 2) an understanding by households that they would lose the community solar benefit if they did not pay their bills on time, which in turn would raise their utility costs.
- Education: The Demonstration Project allowed many utilities to also market (or require) energy efficiency programs and upgrades. Common energy efficiency programs do not have a large uptake of low-income households due to costs and outreach and marketing challenges.
- Staff education: The projects provided valuable renewable energy experience (including O&M) to utility staff members.

Reduce Costs for Low-Income Households and Utilities

- Lower costs: Every utility that participated listed the ability to reduce electricity costs to low-income households as a top project objective. This was true even in the face of a loss of revenue. Making an impact to low-income households and being able to better serve all members and not just those who can take advantage of utility rebate programs, was often more important than the utility financial outlook.
- Cost effective: Solar has become cost-effective for many utilities; therefore, driven by the reasons listed above, interest has grown on how to figure out the best ways to increase solar on their grid.

Support and Build Community

- GRID and CEO support: All utilities mentioned the benefits of having support from GRID and CEO throughout the project. For many, the expertise GRID brought to the project made them comfortable with moving forward with the innovative Demonstration Project.

"Poudre Valley Rural Electric Association is pleased to partner with GRID Alternatives and the Colorado Energy Office on a solar project to benefit cooperative members who have desired to participate in solar energy but have been unable. The Coyote Ridge Community Solar Farm exhibits the cooperative nature of our local electric co-op – it brings all of our members together by providing an opportunity to participate in the construction and energy output of the solar farm."

-PVREA President and CEO Jeff Wadsworth

[28] For more information please see: http://www.leg.state.co.us/clics/clics2015a/csl.nsf/fsbillcont3/4D7BFC7688B8CEB387257DA4000311AC?open&file=046_enr.pdf

- Community non-profits: Several utilities partnered with a local community group to help with outreach efforts. This helped build relationships within the community.
- GRID "barn-raising" model: Utilities appreciated that GRID used a "barn-raising" installation model to build the solar arrays. The "barn-raising" model reduced the costs of the installations, while increasing the communities' ownership of the projects' success.

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Increase Public Relations

- Marketing: By participating in the Demonstration Project, utilities received a large amount of free and low-cost marketing including press releases, newspaper and radio stories, kick-off events, and (in some cases) appearances by the governor.
- Increased use of community solar: Several utilities expressed that they preferred community solar over rooftop solar due to costs or O&M. This program helped increase the communities' knowledge of the many benefits of community solar.

Acquire Community Solar at an Affordable Price

- CEO grant: CEO support was the largest driver for all utilities. For many, it was a critical factor to get their boards or city councils to sign off on the project. The grants also improved each utility's long-term returns significantly.
- GRID's pricing: Several utilities mentioned that GRID provided a very cost-effective proposal that was on par with comparable sized renewable energy projects.

3.4.1.2 Reasons Why Utilities Did Not Participate in the Demonstration Project

In addition to the eight Demonstration Project partners, several other utilities were approached to participate. These utilities provided background on why the Demonstration Project was not a good fit for their utility and/or region.

Expensive Investment

- Price of solar: While the cost of solar is decreasing rapidly, it may currently be more expensive than alternative electricity options. While one utility believed solar would be the cheaper option in the next few years, they did not believe it was cheaper at the time of the project (2016). As a result, they stated that it was inappropriate to offer a more expensive electricity source to low-income subscribers. If they wanted to offer cheaper electricity they indicated that they would offer [large scale] hydroelectricity, which is the cheapest electricity in their portfolio. Another utility noted that ongoing bill credits and REC payments associated with community solar gardens costs utilities approximately two to five times more than a comparable project using utility-scale wind.
- Price of solar, GRID proposal: Per one utility's feedback, GRID was proposing a higher cost per watt compared to other solar developers that had approached the utility. In addition, the utility believed that they could install solar at a cheaper price than GRID.
- Size of projects: The project that was proposed by CEO was small. One utility was only interested in solar at a large scale (over 1 MW). For example, they had recently installed a 13 MW solar installation on 150 acres. They believe that large scale solar is much more cost-effective then smaller projects. In addition, the small size of the projects proposed by GRID (except for the PVREA project) made it cost prohibitive to include a tax equity inventory that could utilize the Investment Tax Credit.

Low-Income Carve-Out

- Unsure if solar is the best way to lower costs for low-income households: One utility stated that they believe there are better ways to support low-income households including:
  - Providing direct bill assistance to low-income households through EOC and/or other local organizations. For example, the utility matched customer contributions and provided additional donations to local organization for bill assistance.
  - Reducing costs overall. They stated they were much more interested in making electricity cheaper for all residents. In return, they would be able to help all low-income households, not a select few.

Wholesale Contracts

- Wholesale contracts: Several utilities specified that they were limited to how much distributed generation they could put on the grid due to their contract with their wholesaler. See the *Wholesale Best Practice* subsection for more information regarding wholesale contracts.

Marketing and Administration Costs

- Lack of demand for community solar: One utility stated that they had not heard interest in community solar from their subscribers even though they had specifically asked for subscribers to reach out to them if they were interested.
- Administration costs: One utility was concerned with their ability to establish whether a household was considered low-income and, therefore, able to receive the benefit. They also did not want to be responsible for "policing" the program to ensure that households continued to meet low-income requirements over the lifetime of the project.[29]
- Marketing community solar: One utility stated that they see the grid holistically and they are uncomfortable telling individuals that they are "using solar", when realistically they are getting the same electricity as everyone else.

Other Reasons

- Disingenuous concept: One utility believed the Demonstrations Projects were trying to "marry two feel good ideas" by combining renewable energy and low-income services. They believed there were more appropriate ways to increase renewable energy use and reduce electricity costs for all low-income households.
- Timing: One utility stated that the timing for the program was not ideal for them for personal and professional reasons. If the program was available in future years, they would be willing to potentially participate.
- Already committed to low-income community solar gardens: One utility stated that they are currently working with private developers to develop low-income community solar gardens, and they wanted to pursue a "wait-and-see" approach before committing to additional low-income community solar offerings.
- Future Xcel Energy requirement: One utility believed that in the future the lump-sum upfront REC payment from Xcel Energy's low-income CSG settlement would improve the financial analysis of a potential project. Therefore, they were not interested in current projects.

[29] It should be noted that GRID typically verified income qualification on behalf of the utilities.

3.4.2 Subscriber Drivers

3.4.2.1 Motives to Participate in the Demonstration Project

Subscribers provided a diverse list of reasons of why they decided to participate in the CEO Demonstration Project.

Reduction in Utility Costs

- Cost savings: Every subscriber mentioned the reduction in their utility costs as being the top reason for participating.
- Alternative to rooftop solar: Several subscribers had attempted to utilize rooftop solar to reduce costs, but the upfront costs were too expensive. Community solar helped them achieve cost reductions while supporting solar.

Environmental and Community Benefits

- Environmental benefits: Many subscribers were very excited about the environmental benefits of community solar.
- Community benefits: Many subscribers felt a lot of pride that their community was trying out something so progressive. They wanted to make sure to support and encourage their utility to do more.

Ease of Signing Up

- Ease of signing up: Every subscriber mentioned that signing up for community solar was very easy.

3.4.2.2 Motives to Not Participate in the Demonstration Project

Several subscribers mentioned a few hesitations in participating in community solar.

Trust

- "Too good to be true": Several subscribers shared their hesitation of signing up since they had to do very little work to receive such a large benefit. Many of them eventually signed up since they trusted their utility and/or the community partner that helped support the project.

Paperwork

- Paperwork: To qualify, households had to fill out paperwork. Several subscribers said the paperwork took some time to fill out. Alongside the bill they had to provide a 1040 form for each adult living in the household and the most recently filed Federal Income Tax Return and recent utility bill. Several households are multicultural or multilingual leading to potential communication breakdowns and/or struggles.
- Privacy concerns: Several interviewees mentioned their hesitation to share their data.
- Time delay between signing up for the program and receiving benefit: For several of the utilities there was a large gap in time between when they filled in the paperwork and when they received the benefit. This led to some individuals to lose some trust in the process. It was noted that once the benefit/credit started to be received this distrust was lessened.

4. Variables that Influenced Project Structure

The Demonstration Project developed a portfolio of low-income community solar models that help identify which variables are most likely to influence project structures.

4.1 Weather and Use Patterns

Weather and Climate Variables

- Weather patterns: Many of the projects are located in colder climates where the sun shines less, resulting in lower production than in sunnier climates. However, in all but one case, the community solar gardens produced more electricity than expected.
- Snow pack: Several communities experience significant snow pack that can cover panels for days and weeks at a time. Snow pack can lead to higher costs since panels need to be installed higher off the ground and snow pack can lead to higher O&M costs due to clearing off the snow.
- Varying peak times: Solar can help shave off peak electricity demand, thereby saving costs, if peak electricity demand occurs when the sun shines. Several of the projects' peak electricity demands aligned with solar production. This was especially common with utilities located in warmer climates that led to a higher amount of air conditioning demand (i.e. Poudre Valley and Fort Collins). For example, one utility experienced a 14 percent bill peak offset on the project, saving a significant amount of costs to their wholesale utility. Utilities located in colder, mountain communities did not always experience as great a benefit of shaving peak demand because they did not utilize as much air conditioning or the electricity demand aligned with tourism or resort activities such as snow making. It should be noted, that even if peak demand savings were achieved, Tri-State did not allow their utility members to get credit for demand savings.

Utility Use Patterns

- Varying base load: Base load can be very dependent on the local economy. Many of the utilities that participated in the Demonstration Project have a big discrepancy due to winter tourism. For example, one utility had a base load of approximately 80 MW but a peak load demand of 270 MW during ski season due to snow-making, electric heat, and tourism. This can affect the ability for a utility to utilize solar for several reasons:
  1. Solar systems produce more electricity in the summer than the winter.
  2. All of the utilities purchase electricity through a wholesale provider that put a limit on how much electricity a utility can produce. In all cases, utilities are not allowed to produce more electricity than they consume.
  3. Several utilities use larger amounts of electricity for heating, such as those servicing mountainous areas, where natural gas and propane may have been unavailable until the 1980s. Therefore, there is a huge increase in electricity demand in winter months when solar produces less electricity.

4.2 Contractual Obligations

Utility Motivations and Goals

- Community and Board demand: Even without renewable energy regulations, many community members and utility boards wanted more renewable energy on the grid. They wanted to diversify their electricity mix, increase local energy sources, and tap into the technology's environmental benefits.
- Renewable energy regulations. All utilities have state-mandated renewable-energy goals that incentivize the use of distributed generation within their community. Each project helped utilities meet or exceed these requirements. Utilities that needed to increase the amount of renewable energy to meet their requirements might be more driven to utilize community solar.
- Internal renewable energy or carbon reduction goals: Several utilities have goals that went above and beyond these requirements. For example, Fort Collins Utility's internal goals require that their grid consists of 20 percent renewable energy by 2020, 80 percent renewable energy by 2030, and 100 percent renewable energy by 2050.

Wholesale Power Purchase Agreements

- Wholesale power purchase agreements: Factors like where a utility purchases its power and how the contract is structured greatly affect the ability to provide community solar (i.e. sometimes a contract limits how much can be produced locally) and payback (i.e. even if power is produced locally, the utility may have to pay the wholesale power provider a fee for producing power). In addition, some wholesale providers did not allow utilities to recoup savings from offsetting peak demand. In the event that they had been able to receive demand savings, the utilities could have generated thousands of dollars per year -- enough to completely or partially offset the lost revenue over the 20-year period. An in-depth review of this critical issue can be found in subsection *Summary of Program Considerations*.
- Wholesale electricity rates: Many utilities were required to pay their wholesale provider for the electricity consumed by their subscribers even when that electricity was offset by the community solar garden. Utilities were then responsible for balancing four rates: wholesale provider bill credit rate, wholesale electric rate, subscriber bill credit, and the retail rate. This often resulted in annual subsidy by the utility. An in-depth review of this critical issue can be found in subsection *Summary of Program Considerations*.

4.3 Implementation Variables

Location of the Array

- Cost and the location of the land: Nearly all the utilities were able to install the array on land already owned by the utility and, for the ones that did not, they were able to install it on unused and unwanted land – a brownfield. This significantly reduced capital costs and improved the ease of interconnection.

"Local folks helped out logistically. In one instance, we found a local farmer and were able to call upon him for trenching equipment. In another case, we employed a neighbor's relatives to help with concrete work. Part of the success of this project was due to the fortitude of the locals."

– Kam Jaspal, GRID Alternatives Land/Project Development Manager

Permitting

- Permitting costs and permitting delays: Most utilities were exempt from the state electric permits since the arrays were installed on land owned by the utility. One utility had additional permitting costs due to installing the array on landfill. This permitting process also significantly delayed the project.

4.4 Administration Variables

Administration Costs

- Outreach and marketing costs: Several of the projects will experience higher administrative costs related to getting new customers. This is due to the fact that some of the projects limit the participation to one year, while others allow for each subscriber to benefit for five years. This means that some utilities will have annual recruitment and administration costs, while others will experience the majority of these costs in five-year cycles.
- Operation and maintenance costs: It should be noted that often operation and maintenance costs were not shown to be significant driver of project design. Based on research performed by the Department of Energy, O&M costs have been quantified at roughly $16 to 20 per kW per year. Considering an average project size of approximately 185 kW (see Table 8), this equates to an estimated annual cost of $2,960 to $3,700 and does not greatly impact project returns.[xlvi] However, one utility had to replace their inverter immediately, which caused them concern over O&M efforts for future projects.

4.5 Financial Variables for Utilities

The utilities' revenues for the low-income community solar projects are smaller than they would have been under the business-as-usual case, since subscribers are paying a lower rate after enrolling in the community solar program. Because Colorado is a regulated power market, it is also important to define utility return, as well as "business-as-usual" in the context of this analysis. In Colorado, all utilities can own generation assets like community solar arrays; however, co-operative and municipal utilities in Colorado still rely on wholesale energy providers to generate electricity and do not typically own many generation assets. Co-operatives and municipal utilities primarily manage the transmission and distribution infrastructure to deliver the electricity generated by wholesale providers and recover their expenses from customers through their electric rates. Because most of the co-operatives and municipal utilities are not taxable entities, they do not recognize profits or losses in the same way that a for-

profit utility would. Therefore, for analysis purposes, any utility returns in this context will be defined as the net-present value of project cash flows, with the disclaimer that the co-operatives' and municipal utilities' regulatory context may allow them to prioritize financial decisions differently than a for-profit utility would.

"The biggest hurdle was getting to a point where the cost to the utility and the benefit to the participant were both manageable."

-Jim Heneghan, DMEA Renewable Energy Engineer

4.5.1 Factors Influencing Utility Return

Capital Costs

- CEO grant: One of the largest impacts on a project's return was the purchase price of the solar system. The CEO grant was designed to help offset some of the capital cost to help improve project returns. Two utilities did not pay for any upfront system costs, which resulted in a much lower overall net-present cost relative to other utilities that paid for up to 50 percent of the project cost. The systems' installed costs also varied between $1.55 per watt to $3.75 per watt.
- Size: Larger project sizes allow for economies of scale that generally result in lower overall system pricing. Due to the greater capital cost of large projects, tax equity investors may be more likely to partner with project developers to take advantage of the tax incentives. Of the eight solar garden projects, only one project was over 1 MW, which may have contributed to the seven smaller projects having higher costs relative to national system cost averages (estimated by GTM Research to be $1.62 per watt (on a dollar per watt basis)).[xlvii]

Project Financing

- Investment Tax Credit (ITC): One factor that could influence future projects' returns is the ability to take advantage of the federal tax credit. This incentive is a tax credit based on a percentage of the system's total qualified basis. Currently, the commercial ITC is set at 30 percent of a project's installed costs, but the percentage of the incentive is scheduled to step down over time. Because this is a tax credit, entities without a taxable income are unable to take direct advantage of this benefit. Non-taxable entities may still be able to benefit from ITC savings under an arrangement in which a taxable third party owns the system, takes the tax benefit, and passes value on to the non-taxable electricity off taker.

  The scheduled stepdown of the ITC is provided below:

  - Present – 2019: 30 percent
  - 2020: 26 percent
  - 2021: 22 percent
  - 2022 onward: 10 percent commercial, 0 percent residential

  It is worth noting that the time required to develop and build a solar project can range from one year to several years. Project delays can result in a drop in the ITC benefit (if it occurs during a stepdown period). The benefit reduction can be especially acute if a project's completion date slips from 2021 to 2022, which would cause a drop from 22 percent to 10 percent in the ITC, as shown above.

  Although the ability to monetize the ITC can help with project bankability, in some cases, it may not be a necessary ingredient for a project to move forward. For example, of the eight utilities that developed community solar under this Demonstration Program, only the PVREA project was able to take advantage of the ITC tax benefits.

- Modified Accelerated Cost Recovery Schedule (MACRS): MACRS allows for an accelerated depreciation schedule, which provides additional tax benefits to a solar project owner. Similar to the ITC, a project owner with sufficient tax liability to use this benefit is required, but if the owner is not a taxable entity, transaction structures exist to allow a third party to take advantage of this benefit. The PVREA

transaction was the only one that took advantage of MACRS tax benefit.

A notable feature of these projects was the fact that only one of the co-operative or municipal utilities choose to work with a taxable entity to take advantage of the federal ITC and MACRS. Although they could have partnered with a taxable entity willing to invest in the project in exchange for the federal tax incentives, these projects were generally too small to attract these entities' interest. Incorporating a tax equity investor involves additional legal and other transaction costs that could significantly reduce the overall returns of small projects. The PVREA-led project found a way to work with a taxable entity under the utility. If the non-taxable utilities had been able to take advantage of these incentives, the return for each project would have increased by $123,000 on average, assuming a 40-percent tax rate and sufficient tax liability. This is a significant improvement in the project returns. For example, if the utilities had taken advantage of the tax incentives, they could have offered a 60 percent subscriber utility bill discount while still earning the same revenues as if they had offered a 20 percent discount and not utilized the tax incentives.

- Project financing: Where grants and utility capital are unavailable, financing may be a viable option to cover project costs. Project financing can reduce the amount that a utility has to contribute to the initial construction cost and provide tax benefits, but also adds risk to a project. Projects can be financed through a third-party ownership arrangement or through a loan. Third-party ownership of a community solar system is a common approach that allows the non-taxable utility to avoid any upfront system costs. Under this arrangement, the third-party developer is responsible for the financing and development of the community solar system. This legal agreement can take the form of either a lease (where the utility pays a fixed rate per month, regardless of the electricity generated) or a power purchase agreement (PPA), where the utility pays for each kWh generated. For additional detail on third-party ownership, see *Appendix B: Alternative Utility Project Structures for Solar*.

  PVREA was the only project in the Colorado's demonstration project portfolio that was financed through a lease, in addition to a partnership with a tax equity investor that could utilize the incentives. Additional detail on this approach is included in *Appendix B: Alternative Utility Project Structures for Solar*.

- State and Federal Grants: As previously noted, all of the projects included in the CEO Demonstration Program received additional grant funding from CEO that ranged from $0.60 per watt to $3.75 per watt (40 percent to 100 percent of project costs), which was critical to improving the overall project returns. Although the CEO Demonstration Program has already been implemented, there are other existing state incentives for community solar projects, such as the New York State Energy Research and Development Authority Affordable Solar Program and solar renewable energy credit (SREC) markets in states such as New Jersey and Massachusetts.

Savings Structure

- Solar payment: Utilities used a variety of funding and financing sources to pay for their portion of the initial capital investment and then received payments from the subscribers. Balancing the solar payment rate, the subscriber savings goal, and the capital investment, were the key factors that dictated project size and the number of households served. Many utilities set the solar payment at a cost low enough to ensure that subscribers received a certain percentage of savings on their bill (15 percent to 50 percent).

Impact of Bill Credits

- Bill credits: Most, but not all, participating utilities structured their projects so that the subscribing low-income households would realize a 50 percent cost savings. One utility opted to offer lower customer savings, so they could stay budget neutral. This resulted in a subscriber cost savings of 10 percent to 15 percent. Two of the utilities also received REC payments from their wholesale electric providers for the electricity generated from their community solar system. However, the REC payment from the wholesale provider was not large enough to fully offset the 50 percent cost savings for each subscriber, meaning that these two utilities still received lower revenues than they would have under their standard rates. The subscriber credit provided to low-income subscribers played the most significant role in determining the overall utility return for the projects.

5. Factors Influencing Subscriber Savings

"A subscriber of Phases 2 through 4 was moving into a new home. She specifically looked for a home that was served by GVP so that she could re-enroll in the community solar project."

-Derek Elder, GVP Member Service Manager

Prior to their enrollment in the community solar projects, the low-income subscribers in the programs previously paid utility retail rates for electricity ranging from $0.06 per kWh to $0.13 per kWh and fixed monthly charges ranging from $9 to $32 per month. After enrolling in the community solar projects, subscribers paid community solar rates for electricity ranging from $0.02 per kWh to $0.08 per kWh and paid the same fixed charges. Their fixed charges were not offset by program enrollment. Electricity rates decreased by approximately 39 percent to 80 percent, while fixed charges remain the same. See Table 9.

Utility Name	Retail Rate ($/kWh)	Fixed Rate ($/month)	Bill Credit ($/kWh)	Solar Payment ($/kWh)	Reduction in Retail Rate
Delta-Montrose Electric Authority	$0.105	$25.00	$0.065	$0.040	62%
Empire Electric Association	$0.096	$32.00	$0.072	$0.024	75%
Fort Collins Utilities	$0.097	$6.14	$0.076	$0.021	78%
Grand Valley Power	$0.102	$30.00	$0.102	$0.020	80%
Holy Cross Energy	$0.099	$9.00	$0.079	$0.020	79%
Poudre Valley REA	$0.094	$24.50	$0.066	$0.028	30%
San Miguel Power Association	$0.135	$18.00	$0.053	$0.082	39%
Yampa Valley Electric Association	$0.061	$24.00	$0.031	$0.030	49%

TABLE 9: SUBSCRIBER UTILITY RATES

The projects collectively resulted in 380 low-income households receiving a solar benefit that equates to, on average, a 15 to 50 percent reduction in their total utility bill cost, or $130 to $590 per year in savings. There are several key factors that influence this wide range in subscriber savings, including: the utilities' bill credit structure, rate escalation, fixed charges, annual usage, and credit carryover. The calculation of the full subscriber bill cost, and the major factors that influence it, is summarized in Figure 11, and are discussed in more detail in the sections below.

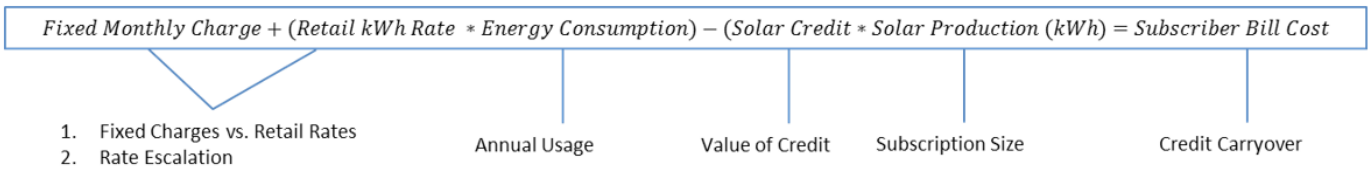


FIGURE 10: SUMMARY OF MAJOR FACTORS INFLUENCING SUBSCRIBER SAVINGS

Bill Credit Structure and Subscription Size

The value of the bill credit is the largest determinant of low-income subscribers' savings, but the subscription size is also extremely important. Under this program, the utilities assign a portion of the capacity of the community solar system to each subscriber (the subscription size) and then apply a credit to subscribers' bills based on the production associated with their portion of the system. Balancing the level of subscriber credit with the subscription size is a key consideration for future projects.

- Smaller size: Smaller subscription sizes allow the program to reach more households, but with a smaller savings impact per household. For example, one of the utilities provided a subscriber credit that equaled the bill credit payment that they received from Tri-State and established a 2-kW maximum size per subscriber to encourage broader participation. However, the smaller subscription size also resulted in households realizing lower savings, since the production from the 2-kW system was well below the households' annual load. For instance, a subscriber might have an annual load of 10,000 kWh, but a 2-kW system might only produce 2,000 to 2,500 kWh in a year, which is insufficient to realize a 50 percent bill savings.

- Amount of electricity: Most of the utilities attempted to cover 100 percent of the electricity consumed, which provided the maximum opportunity for cost savings potential.

Rate Escalation

- Rate escalation: Several projects' enrollment terms increased the subscriber bill credits annually to account for inflation and projected annual increases in electricity rates (commonly referred to as "escalation rate" or an "escalator"). Escalation rate proved to be another key driver of subscriber returns over the full project term. The subscription terms varied by project, but generally included the subscribers for one to five-year terms. One utility will limit its subscription duration in order to cycle in new subscribers every few years. Others will remove subscribers if they exceed the low-income income requirements. Utility rate escalation over 20 years can significantly erode the benefit of a bill credit that does not escalate along with it. Most of the projects set their customer bill credit to escalate alongside electricity rates, which preserves the percentage savings of the program over the 20 years and obviates the need to estimate the rate escalation.

"It is a big thing to know what our bill costs will be for the next few years. It helps us with budgeting."

-Steve Sidebottom, DMEA Subscriber

Fixed Monthly Charges

- Fixed monthly charges: How much a customer is charged monthly to access electricity from the utility considerably affects their overall savings. Under all of the projects, subscribers continued to pay the same fixed monthly charges. These fixed charges are typically intended to cover the utilities' transmission and distribution infrastructure costs, overhead, and other fixed costs distributed equally among all utility customers. After analyzing the potential for larger subscriber savings, it appears that even reducing the subscribers' retail rate to zero would only result in at most a 50 percent reduction in subscribers' utility bills, due to the fixed bill charges. This indicates that different billing approaches include a credit towards both the retail rate and fixed bill charges, rather than just the residential retail rate, may be necessary to reach higher bill reductions in the future. However, there are also fairness considerations surrounding the reduction of fixed charges. Solar subscribers also rely on the transmission and distribution grid to receive and occasionally export power, and there is debate across the country about how these services should be valued.

Annual Usage

- Annual usage: Some of the low-income households included in the community solar projects were originally identified through the CEO WAP program. Subscribing customers who had already received weatherization services may have already reduced their overall electricity demand. Customers with lower annual usage require a much larger bill credit in order to achieve similar savings percentages due to the impact of fixed monthly charges on the customers' total bill. However, providing a larger credit still does not guarantee larger percentage savings for subscribers; those with higher fixed charges and large loads received a smaller overall savings benefit as well. In addition, households with higher usage might have not been able to offset a significant portion of their electricity due to the cap that utilities put on allocation of solar. For example, some households would have required subscriptions of over 10 kW in size to offset their annual electricity use, but were only able to receive an allocation of 5 kW due to program rules.

  As a key takeaway, utilities considering a low-income community solar program should examine the overall subscriber benefit, not just the percentage reduction in rates.

Bill Credit Carryover

- Bill credit carryover: One disadvantage of the crediting approach used by the utilities (crediting based on solar production), is that solar production varies seasonally in higher latitudes, resulting in much higher production (and lower bills) in summer months and the converse in winter. Due to these seasonal variations in solar production, this may result in subscribers offsetting 100 percent of their utility bill costs in the summer months, but paying most of their bill during the winter. These fluctuating utility bill costs can make it challenging for a low-income household to budget across the year.

  One solution to this problem is to allow a subscriber to carry over credits for excess generation in the summer (like in similar to traditional net energy metering arrangements). If the household uses less electricity than their allocation of the solar array production produces, they can retain the credits (hold onto them until to offset future use when the household consumes more electricity than the solar array produces) and/or receive a true-up payment at end of program term for any excess credits (in the form of a check). Every utility within the Demonstration Project allowed for this credit carryover this.

  Another potential billing approach would be to lower subscribers' utility rate for all power purchased pro rata, based on the expected solar production versus household consumption. This approach would be more dependent on an upfront estimate of the system's production, but would provide greater certainty for the subscribers on a monthly basis surrounding the bill levels month to month and while still encouraging energy conservation. However, this approach would be subject to regulatory requirements that may prohibit different rates for customers

Length of Subscription

- Subscription periods: Subscription periods for enrolled low-income households ranged from one to five years, depending on the project. Turnover of low-income households is an issue faced by many low-income community solar projects, and maintaining full subscription of the projects while rotating the community solar subscriptions to a broader group of subscribers is often a key challenge. The ability for subscribers to save money is dependent on the length of their subscription. Subscribers with a one year term will see smaller total savings from participating in the program and may be less inclined to participate in the program.

"We are on Social Security. We didn't know how we would make it through this winter. This [program] was the answer"

–Lloyd Gallion, EEA Subscriber

6. Summary of Program Considerations

Throughout the Demonstration Project, CEO, GRID, and partner utilities recorded a list of best practices and lessons learned to inform future low-income community solar projects. The following is a menu of best practices from a marketing and programmatic perspective for utility led community solar offerings that may help improve connection with the low-income market, increase the uptake of low-income community solar, and reduce administration costs. Not all of these practices need to be pursued to ensure a successful program, but a combination of these practices may strengthen a community solar offering. Table 10 outlines a list of best practices and parties that may be responsible for implementing the best practice. [30]

6.1 Marketing and Communication Considerations

The following are marketing and communication best practices that could help create efficiencies by improving marketing material, clearly identifying savings opportunities and consumer protection issues, and highlighting energy efficiency and energy justice issues.

Considerations	Potential Responsible Party			
Marketing and Communication Considerations	*Utility*	*Project Developer*	*Non-Profit/Housing Authority*	*State/Local Government*
Partner with local, trusted organization(s)	X	X	X	X
Integrate community solar with complementary programming	X		X	
Set clear cost saving expectations	X	X	X	
Clearly outline consumer protections	X	X		
Minimize legalese	X	X		
Create a waitlist	X	X	X	
Use multiple modes of communication		X	X	
When "not-in-my-backyard" issues are at play, work with community to develop community garden	X	X	X	
Direct marketing materials at low-income communities' priorities	X	X		
Ensure clear contact	X	X		
Make sure timing is clear	X	X	X	
Research bill software in advance	X			
Simplify billing and have transparency in bills	X			
Simplify customer acquisition	X	X	X	
Have a kick-off event	X	X	X	

TABLE 10: MARKETING AND COMMUNICATION CONSIDERATIONS

- **Partner with local trusted organization(s):** Utilities should consider partnering with a trusted, local organization to help with outreach. Once the partnership is formalized, potentially create co-branded materials that outline community solar benefits. Many Demonstration Project utilities partnered with local organizations that were already working with low-income households on energy efficiency, energy justice, and renewable energy issues. These organizations helped establish trust, open doors, and (in some cases) helped qualify low-income households.
- **Integrate solar with complementary programming:** The Demonstration Project highlights that a comprehensive approach to energy burden reduction can increase program impact and efficiency. Solar is a strong complement to low-income weatherization programs as a cost-effective measure to reduce electric energy burden.
- **Set clear cost saving expectations:** Expected cost savings and the specifics of the cost savings (i.e. timeline, estimated savings amount, etc.) should be clearly laid out and easy to understand. Any financial contribution from low-income

[30] Note that many of the programmatic and policy best practices are from the Colorado Energy Office report Analysis of the Fulfillment of the Low-Income Carve-Out for Community Solar Subscriber Organizations by Lotus Engineering and Sustainability.

subscriber must be clearly outlined. Each project expected a different level of savings per subscriber and within each project there was a wide range of potential savings. For example, the HCE subscriber allocations ranged from 0.53 kW to a maximum of 5 kW and due to a broad range of electricity use, the expected savings ranged for subscribers from 15 percent to 50 percent. It is very important that the expected savings match the expectation of the subscribers.

Savings will also range seasonally due to weather and consumption patterns. Subscribers must understand that some months they might save significantly more than in other months.

The subscribers must also clearly understand when their benefit will end. Each project provided the benefit of community solar from one- to five-year terms and several utilities allowed the subscribers to reapply once their contract expired. It is recommended that the utility give adequate notice when the benefit will end.

- **Clearly outline consumer protections:** Low-income households must have strong consumer protection clauses to protect them from hidden fees, fines, and/or penalties (i.e. overdue payment, contract termination, rate escalators, etc.) that they are unable to pay.[31]
- **Minimize legalese:** The contracts should be easy to understand.
- **Create a waitlist:** Utilities, developers, non-profits, and housing authorities should build a waitlist. Many of the utilities in the Demonstration Project mentioned that the low-income population were more transient so there was a high chance that new subscribers would need to be found year-round.
- **Use multiple modes of communication and outreach:** In order to get a household to sign up, use several modes of communication (i.e. utility mailers, phone, email, mail, billboards, and/or advertise on utilities website). Several utilities mentioned they had positive response using radio ads. In addition, GRID and the utilities advertised and provided in-person workshops. While many of these workshops were not well attended, there was a very high rate of households signing up and completing their paperwork on the spot -- reducing marketing costs.
- **When "not-in-my-backyard" issues are at play, work with the community to develop the community solar garden:** Getting early buy-in on site placement, using local contractors, and touting the benefits of clean energy can help overcome legacy biases against renewable energy systems.
- **Direct marketing materials at low-income communities' priorities:** Marketing materials must be targeted to low-income households and highlight the priorities for that community. Marketing materials should be multicultural and multilingual, as needed. Subscribers noted that the most important marketing aspects were the potential for much lower bills and (almost as important) more consistent, predictable bills through locked in bill credits.
- **Ensure there is a clear contact:** Ensure that even if there are multiple parties involved, there is one single, consistent contact for interested and signed up subscribers.
- **Make sure timing is clear:** Ensure that there is minimal delay between when subscribers sign up, are accepted, and receive their benefit. This will minimize confusion and build trust, while increasing satisfaction with program.
- **Research billing software in advance:** New software, such as software that calculates and administers bill credits, may be difficult to master at first. Spend time researching software and training staff up front and contacting utilities or partners who have implemented similar programming, especially those that share a utility's software platform.
- **Simplify billing and have transparency in bills:** The utility should make sure that the benefit is clearly highlighted in the monthly bill. If the credit is not highlighted, then the households might not understand whether or not they are benefiting from community solar.

[31] For more information see Appendix B of the Colorado Energy Office report *Analysis of the Fulfillment of the Low-Income Carve-Out for Community Solar Subscriber Organizations* by Lotus Engineering and Sustainability.

- **Simplify customer acquisition:** Currently one of the larger soft costs for community solar is customer acquisition. This is largely due to the fact that it is hard to figure out which households qualify as low-income and many developers/utilities do not have the systems in place to identify qualified households. GRID qualified all households (except for the Fort Collins Utilities project where participants were pre-qualified through LEAP); however, moving forward developers and utilities expressed discomfort of income qualifying households.

  Potentially, low-income programs (i.e. CEO WAP, EOC) with a large pool of customers that are already low-income qualified could share their program contact pools with developers and utilities. Each of the solar installations in the Demonstration Projects were able to utilize the CEO WAP's list of pre-weatherized customers saving valuable time and money. Note that several interviewees mentioned their concern over sharing customer data due to privacy concerns; however, a pool would help cut down greatly on the time and costs of customer acquisition.

- **Have a kick-off event:** Have a kick-off event to celebrate the project. GRID helped organize a kick-off event for each utility, which helped celebrate the project's success, build momentum, increase visibility, and boost community involvement.

"Our position as a non-profit organization is essential to our perspective as a utility. We are tasked with serving all members of our community. The best ways to do this, and to bring electricity to the end user, is to develop programs that serve low-income households and support local economic development."

– Wiley Freeman, SMPA Manager of Member Services

6.2 Programmatic Considerations

The following are programmatic best practices that could benefit future community solar projects by creating long-term partnerships, respecting privacy, clarifying low-income eligibility requirements, spreading and trading off the benefit, and improving transparency.

- **Create long-term partnerships with "mission-driven" organizations:** Throughout the Demonstration Project many partnerships were developed between utilities, CEO, and non-profits and housing authorities who work directly with low-income communities. Many of these organizations have missions to work with and directly support low-income households. As such, they already have connections with low-income communities, and in most cases, had developed a strong trusting relationship with individual households, which takes time and consistent communication. Long-term partnerships will increase the efficiency of the community solar subscription process. For example, LEAP has an extensive list of Colorado households that need help paying their utility bills and could benefit from community solar.

  Many of these organizations are already aware of which households are income qualified for the community solar program, minimizing outreach. Also, non-profits focused on energy security know how to explain energy issues to households that are unfamiliar with them.

  In some cases, the utilities will rely on partner organizations to do the majority of outreach and income-qualification for the programs moving forward. In other cases, many of the partner organizations (including CEO WAP program) are providing low-cost or free energy efficiency upgrades to participants.

- **Respect privacy:** Several of the subscribers and partner organizations mentioned the need to ensure the privacy of low-income residents. As such any program must clearly lay out comprehensive consumer protection benefits for low-income residents.

- **Provide a clear and flexible definition of low-income:** There are many definitions of poverty (see the subsection *Poverty Classification* for more information). Utilities expressed the need to ensure that the income qualification requirements are not too strict or many households that could benefit from community solar will miss out. This is especially relevant in many of the mountain communities where housing is so expensive that multiple families will live together. In return, the entire household might not qualify for community solar since their joint incomes might be over the income threshold. Note that all Demonstration Projects used a HUD definition of 80 percent AMI, which was considered flexible enough to include many of the households in need of the program. Ensure that all types of low-income housing are included in program design, such as master metered low-income housing.

- **Rely on community and utility to provide in-kind support:** Costs for each project were reduced by utilizing free community support and in-kind utility support including land, billing software, and ongoing program administration.

- **Connect efficiency, community solar, and cost savings:** Many of the subscribers that benefited from community solar had already utilized CEO's WAP program. Therefore, the connection of energy efficiency and costs savings had already

Considerations	Potential Responsible Party			
Programmatic and Funding Considerations	*Utility*	*Project Developer*	*Non-Profit/ Housing Authority*	*State/Local Government*
Create long-term partnerships with mission-driven organization(s)	X	X		
Respect privacy	X	X		X
Provide a clear and flexible definition of low-income	X			
Rely on community and utility to provide in-kind support	X	X	X	X
Connect efficiency, community solar, and cost savings	X	X		
Spread the benefit	X			
Trade the benefit	X			
Expect a contribution from the subscriber	X			
Focus on the solar payment structure	X			
Fixed charges play a significant role in the potential for reducing energy costs	X			
Guarantee the bill credit	X			
Carry credits forward	X			
Install array on utility-owned land	X			
Purchase larger arrays	X	X		
Structure the project to take advantage of federal tax incentives	X	X		
Explore municipal financing options	X	X		X
Educate utility staff about renewable energy, generation, transmission, and distribution practices	X			

TABLE 11: PROGRAMMATIC CONSIDERATIONS

been made. However, for participants that had not already completed energy efficiency upgrades, many utilities were pushing energy efficiency alongside community solar. The utilities were doing this for several reasons:

- Open communication: Since the utility was already communicating with the households for the community solar program it made it easier to promote and discuss additional cost saving programs.
- Motivated households: Many of the households that signed up for community solar were motivated to increase energy efficiency or renewable energy due to cost savings, increased comfort, and/or environmental benefits. Since the households were already motivated it was more likely they would consider energy efficiency as well.
- Savings after the benefit is gone: Utilities wanted to ensure that the subscribers were able to see cost savings even after their community solar benefit no longer existed. One subscriber stated that his family was utilizing the cost savings from community solar to complete additional energy efficiency upgrades on his home (see the *Holy Cross Energy case study* in *Appendix A*). In return, he would have long-term cost savings after the community solar benefit was no longer available. The Fort Collins Utilities project was specifically designed to achieve long term savings and help families no longer need LEAP assistance.

"Efficiency already made an enormous difference for costs and comfort. My house is tri-level so there was a significant difference in temperatures from floor to floor. During the winter, with baseboard electric heat, my first floor was warm while the top floor cold. In the summer, it is the opposite. Weatherization significantly helped reduce this temperature difference."

– Laura Wilson, Subscriber for Fort Collins Utility Community Solar Project

- Increased trust: Several of the subscribers mentioned that they trusted their utility or were happier with the utility after they started saving money with their community solar subscription. Due to this new level of trust, households may be more likely to try other cost-saving programs provided by the utility.

- **Spread the benefit:** All projects put a limit on the amount of community solar a household could be allocated (usually up to 5 kW). This was done was to ensure that the most number of low-income households were benefiting from community solar. For example, to offset 75 percent of one of HCE's subscriber's electricity demand, Holy Cross Energy would have had to allocate 24 kW (about 17 percent of the total array) to that household. By capping the subscription at 5 kW, more households can benefit. Note that the allocation must be high enough to create significant savings for subscribers.

  Another way a utility may distribute the benefits is by capping the amount of electricity the community solar array can offset. In general, the Demonstration Projects aimed to offset between 75 percent and 100 percent of a household's total electricity use (up to the aforementioned cap). By lowering this percentage, more households could benefit. For example, a low-income subscriber could have 50 percent of their annual consumption of electricity covered instead of 100 percent allowing more households to participate.[32]

  Both approaches leave room to encourage continued energy efficiency and consumption reduction behavior since the customer is still paying the normal rate for some electricity consumption.

  This recommendation might be disregarded if:

  1) The goal of the program is to increase the maximum dollars saved for low-income households, rather than benefit the maximum number of households. If this the case, then it would not matter if the array allocated 24 kW to one household or if the same 24 kW was allocated to multiple households.

  2) If the cost to sign up subscribers is significant then it might make sense to either have a high maximum allocation, or have no maximum to minimize the costs that come from signing up households for the program.

  "YVEA wanted to ensure that solar was available to everyone. Historically solar was perceived to be a rich person's game. This project allowed everyone to benefit."

  – Diane Johnson, YVEA CEO

- **Trade off the benefit:** Each project limited the participation from one- to five- years, with some utilities allowing households to reapply once their contract expired. This was to ensure that the most number of participants received the benefit. Also, utilities wanted to ensure that households that were no longer qualified (i.e. their income level rose) would no longer receive the benefit. The one caveat of this recommendation is that the shorter the contract, the higher the administration costs of signing people up again and it might discourage some households to sign up if they do not believe the benefit is worth their time. In addition, the brief time period might lead to some dissatisfaction with the program.

- **Expect a contribution from the subscriber:** In some low-income community solar models (not in the Demonstration Project), the subscriber does not pay anything for their power. In return, the utility or developer can see significant loses from supporting a low-income project which will inevitably discourage utilities and developers from completing more low-income projects in the future. By requiring the subscriber to make a payment towards the cost of the panels, hopefully, a replicable model can be created in which both the subscriber and utility benefit. CEO's goal for the project was not to provide 'free' electricity to customers, but rather to achieve Energy Cost Parity.

  Even with a contribution from the subscribers in the Demonstration Project, all utilities earned a lower total net income than what they would have under their standard rates. Because the participating co-operatives are not for-profit entities, they do not recognize profits or losses in the same way as a for-profit utility would. However, since co-operatives recover their expenses from customers through their electric rates, this shortfall in net income will either need to be recovered through the co-operatives' retail rates, offset by reductions in the co-operatives' costs, or potentially covered through other municipal financing or grant funding.

  It is important to note that all of the utilities earned a positive return on their community solar projects, but that this return was smaller than what they would have earned if they had continued charging their low-income subscribers the same retail rates. Based on an analysis by the National Renewable Energy Laboratory on what would be required to achieve a break-even return for utilities (under similar CEO grant funding), it was estimated that if subscribers received a 10 to 20 percent reduction on their utility bill, and a utility took advantage of federal tax incentives, they would earn a return similar to what they would have earned under their standard rates.

  The level of subscriber discount (in the form of a bill credit) will directly affect a utility's return. For example, offering a 60 percent subscriber discount will significantly reduce a utility's project returns in comparison to a 20 percent credit.

[32] The current community solar legislation states that a community solar garden for Investor Owned Utilities cannot provide more than 120% of a subscriber's average annual consumption of electricity, with a deduction for the amount of any existing solar facilities at such premises (i.e. if a household already has PV panels on their roof). The 120% rule is based off the Solar*Rewards rules and accounts for variations in annual production and utility based incentives (i.e., bill credits).

It should be noted that a 10 to 20 percent discount is minimal and will most likely not significantly reduce the energy burden of low-income households. In the case of the Demonstration Project, utilities set their own project goals with most aspiring to provide a subscriber with cost savings of about 50 percent. In the future, where utilities are unable or unwilling to accept a lower net income in comparison to business as usual, other sources of funding (such as state incentives), lower project costs, and/or other innovations would be required to achieve larger discounts.

- **Focus on the solar payment structure**: The amount that each subscriber pays to participate in community solar and associated escalation rates deeply affect the subscriber's total savings. The initial spread between what a subscriber normally pays per kWh (i.e. the retail electric rate) and how much they pay after receiving a solar credit, will affect the size of the revenue shortfall that a co-operative incurs, as well as how much the subscriber saves per kWh.

  Escalation rates are also important to project future utility costs and subscriber savings. For example, if a solar credit does not escalate, but electricity retail rate costs do, the spread between the credit and retail rate increases. For example, one utility's subscribers in 2017 will save $0.078 per kWh, while subscribers in 2041 could save approximately $0.121 per kWh. However, increased savings for subscribers may correspond with a greater decrease in net income for the utilities; therefore, the chosen escalation rate must provide a balance between projected utility costs and targeted subscriber savings.

- **Apply bill credits to fixed charges:** Community solar incentives are typically provided as bill credits – credits on electric bills – and are issued as a dollar per kWh amount reduction of the standard utility rate. Fixed charges are not affected. While a subscriber's electric bill will be reduced by the bill credit amount, the subscriber will always be responsible for paying fixed charges. The degree to which a subscriber's electricity costs are reduced is a direct function of the amount of fixed charges relative to the cost of electricity. The higher the monthly fixed fee, the lower the percentage cost savings. Note that for many rural co-operatives and municipal utilities, fixed costs are higher since they often serve customers in lower density areas and incur significant infrastructure and distribution costs as a result. Applying bill credits to the fixed charges as well as the residential retail rates may be a means to increase overall subscriber savings, but could also result in a greater shortfall in utility net income as result.

- **Guarantee the bill credit:** The bill credit is generally the most financially significant benefit to community solar participants. Yet, bill credits are not always guaranteed and may vary monthly or yearly. If possible, the bill credit should be guaranteed during the contract term. The bill credit could also be tied to solar production and value. For the demonstration project, the bill credit was guaranteed to stay flat or escalate at a locked-in rate. This enables for more predictable savings for subscribers and provides protection for low-income households.

- **Carry credits forward:** Household electricity usage varies drastically month to month. For example, households that utilize electric heat have a large increase in demand in the winter, while households that utilize air conditioning might have a large increase in demand in the summer. When a subscriber's allocation of the array produced more than they used many of the utilities allowed these "credits" to carry over on a monthly basis through the end of the subscription period.

  In return, when a household consumed more electricity than their array produced they were able to utilize the additional "credits" and save more money. This was considered a major benefit for subscribers. One subscriber even mentioned that his family was heavily pursuing energy efficiency to ensure that they had "banked" enough credits for the winter months. Allowing for credit carryover, helps to balance the seasonality savings of solar and ensure that households are seeing more predictable savings and utility bills.

- **Install array on utility owned land:** If possible, install the array on land owned by the utility and adjacent to utility headquarters to simplify interconnection and help reduce interconnection costs.

- **Purchase larger arrays:** If possible, purchase larger arrays to take advantage of economies of scale to reduce impact of potential system cost reductions. One solution is to aggregate project demand between utilities and build a larger project.[33] However, larger arrays may meet with opposition in certain places, due to siting concerns and higher transmission costs.
- **Structure the project to take advantage of federal tax incentives:** If a utility is a taxable entity (or has a taxable affiliate) and has sufficient tax liability, then it can take advantage of federal tax incentives for building and owning their community solar project. The federal tax incentives (i.e. the 30 percent investment tax credit and accelerated five-year depreciation) are significant, and would have increased the utilities' project returns by $123,000 on average. Where utilities are not taxable entities, they would have to either partner with a taxable entity willing to invest in the project and take the tax incentives as equity, or enter into a power purchase agreement with a taxable third party that would own the system and take the incentives. Partnering with a tax equity investor can involve significant legal transaction costs, and investors often have a minimum project size requirement for the deals to be worthwhile. This means that smaller community solar projects under 1 MW may struggle to attract tax equity investor interest. See *Appendix B: Alternative Utility Project Structures for Solar* for more information.
- **Explore municipal financing options:** If a utility wants to build and own a community solar project and needs to acquire financing, there are several public financing structures that have been developed in the United States, including Clean Renewable Energy Bonds (CREBS), and the Morris Model [34]. The advantage of these options is typically in the form of lower interest rates and/or the ability to acquire financing when private lenders are unavailable. There are significant transaction costs associated with setting up municipal financing, so utilities should always explore existing public financing options first. If no options exist, the size of the capital requirements should be compared against the legal and policy effort required to enable public financing in the utilities' territory.
- **Educate utility staff about renewable energy generation, transmission, and distribution practices:** Utility staff members may be new to renewable energy systems, and it is important that staff become familiar with new procedures and practices prior to administrating a new community solar program.

"This project was an easy sell to our Board. There is no magic pot of money for rebate programs; they are always supported by all of our rate payers. Low-income households get left behind because they can't pay out of pocket and, because many households rent, they may not benefit from rooftop solar. Here's a program that finally serves these members."

-Derek Elder, GVP Member Service Manager

[33] A notable example of this is the Rocky Mountain Institutes *Shine: Community Scale Solar* initiative where they bulk purchase community solar for multiple utilities creating economies of scale. For more information see: https://www.rmi.org/our-work/electricity/shine-community-scale-solar/.

[34] For more information, please see https://www.cooperative.com/public/bts/sunda/models/Pages/default.aspx

7. Summary of Policy Considerations

Before implementation, all policy considerations (see Table 12) outlined in this section need to be fully vetted for potential financial, programmatic, policy, and political implications. Some of the following policy changes would take a legislative change and/or Public Utilities Commission (PUC) ruling, while others would require a contract amendment or a change in internal policies for a developer or utility. In addition, due to regulations some policies may or may not work or apply to certain utility types (i.e. co-operative, municipality, and IOU). The following list does not represent the perspective of CEO, but instead provides a list of policies that may increase the number of low-income households benefiting from community solar through increased funding.

Potential Policy Changes and Improvements	Potential Responsible Party(ies)			
Wholesale Considerations	*Utility*	*Wholesaler*	*Legislation*	*PUC*
Change or eliminate the cap on distributed generation	X	X		X
Qualifying facilities requirements	X	X	Federal	X
Prevent wholesalers from charging utilities for electricity consumption offset by solar	X	X		X
Allow community solar to count towards demand charges	X	X		X
Purchase Renewable Energy Credits	X	X		X
Funding and Financing Considerations	*Utility*	*Wholesaler*	*Legislation*	*PUC*
Increase the Renewable Portfolio Standard			X	X
Require utility companies to pay for Renewable Energy Credits			X	X
Implement a statewide electricity or carbon tax and/or cap-and-trade program to fund low-income subscriptions			X	
Consider investing a portion of LIHEAP funding into low-income solar installations			Federal	
Require that LIHEAP recipients are enrolled in community projects			Federal	
Pay-as-you-go model	X			
Provide financing for low-income households, if needed	X			
Require that utility Renewable Energy Standard Adjustment (RESA) programs dedicate a portion of funds to support low-income solar installations			X	X
Have utilities provide a mandated or non-mandated funding source	X		X	X
Provide incentives for community solar arrays to be located on brownfields	X		X	X
Contracting and Other Policy Considerations	*Utility*	*Wholesaler*	*Legislation*	*PUC*
Mandate a low-income carve-out for community solar across the state	X		X	X
Provide a preference for low-income participation in solar gardens in bids	X			
Provide targeted support for siting	X		X	
Add to the utilities' mission statements/ mandate to reduce costs for low-income households	X			

TABLE 12: POTENTIAL POLICY CHANGES AND IMPROVEMENTS

7.1 Wholesale Considerations

Each of the utilities involved in the Demonstration Project purchased power from a different wholesale provider (Platte River Power Authority, Tri-State Generation and Distribution, Western Area Power Administration, and Xcel Energy) and has a unique contract that directly affects their ability for community solar to be beneficial or scaled. The following is a list of best practices that focus on the wholesaler and purchasing utility relationship.

- **Change or eliminate the cap on distributed generation:** Each of the wholesale providers capped the amount of generation each purchasing utility could provide locally. Therefore, if the utility hit their maximum percentage they were not allowed to put more distributed generation (including solar) online. This mandate was especially hard for utilities located in areas where electricity demand is steady or even declining. Since the solar projects are expected to stay online for more than 20 years, the utility must be confident their demand will stay steady or increase over that time if they are getting close to their maximum distributed generation allocation. Several utilities worked around this requirement by putting the solar on rooftops or "behind the meter" where it was net metered (in their contract this did not count towards the cap). However, these projects were small and were not able to take advantage of economies of scale.

  With the decrease in costs for distributed generation and the increased demand by constituents for local generation, many utilities are looking to increase their cap through lawsuits or contract negotiations.

- **Qualifying facilities requirements:** Depending on the size of the array, the project may or may not be recognized as a QF under PURPA. A QF can either be a small power production facility (under 80 MW) or a cogeneration facility. All the arrays in the Demonstration Project were classified as QF's, and according to PURPA, the co-operative and municipal utilities were required to purchase the generated electricity. However, at times, PURPA's requirement were in opposition to wholesale provider contractual obligation. Utilities are encouraged to pay attention to FERC's upcoming ruling on PURPA versus wholesale contractual obligations.

  Note that the interpretation of PURPA's requirements depend heavily on the wholesale provider. For example, utilities that worked with Xcel Energy did not have to ask permission to install the small facilities. However, Tri-State was more actively involved with their utilities.

  The local, regional, and federal benefits for QF facilities include: 1) the right to sell energy or capacity to a utility; 2) the right to purchase certain services from utilities; and 3) relief from certain regulatory burdens. The main QF benefit experience are cost savings[35].

- **Prevent wholesalers from charging utilities for electricity consumption offset by solar:** One of the wholesalers, Tri-State, requires that buyers pay for the electricity consumed by its members that is offset by solar. This greatly affects the pro-forma and ability to make community solar be profitable.

- **Allow community solar to count towards demand charges:** One of the wholesalers allows community solar to offset peak demand charges which helps make solar more profitable. On the other hand, Tri-State prohibited the ability for community solar to offset peak demand charges even when the array was helping the entire grid offset peak demands. Consider an arrangement where utilities are allowed to offset peak demand costs through solar.

- **Purchase renewable energy credits:** Depending on the contract, the wholesaler can purchase and retain ownership of the RECs throughout the contract. In return, the wholesaler will apply these to their Renewable Portfolio Standard requirements and the utility that owns the community solar array will not be able to use the RECs to meet their environmental requirements.

7.2 Funding and Financing Policy Considerations

Before implementation, all policy recommendations would need to be fully vetted for potential financial, programmatic, policy, and political implications.

- **Increase Renewable Portfolio Standards (RPS):** Increase RPS standards to boost the amount of solar required to be produced by investor owned utilities, municipalities, and co-operatives. Potentially require a low-income carve out in the legislation.

- **Require that utility companies pay for RECs:** Require that utilities pay REC payments to developers for community solar projects and/or link REC payments to low-income subscriptions. In recent years the value of RECs has dramatically declined and as a result, developers are receiving less financial incentives from utility companies.

- **Consider investing a portion of LIHEAP funding into low-income solar installations:** The State of California implemented solar systems for 1,482 low-income households using LIHEAP ($14.7 million) funds and a match from outside partners

[35] For more information please see: https://www.ferc.gov/industries/electric/gen-info/qual-fac/benefits.asp

($3.5 million).[xlix] The State of Colorado receives significant funding from LIHEAP that could be allocated towards community solar. CEO has already created a successful rooftop solar program and continues to explore other federal options for flexibility in including all solar options.

- **Require that LIHEAP recipients are enrolled in community projects:** The State of New York has recently proposed that all recipients of LIHEAP (also called Home Energy Assistance Program) automatically become enrolled in community solar projects. This has allowed them to access a previously defined market of low-income subscribers and reduces administration and outreach costs. [l]
- **Implement a pay-as-you-go model or on-bill financing:** All Demonstration Projects utilized a pay-as-you-save model in which households did not pay for panels upfront but only paid for the kWh's that they received. Other projects in Colorado have required households to provide upfront capital; however, low-income households rarely have the upfront capital to support a project and many low-income households are unable to get financing due to low or no credit scores.
- **Provide financing for low-income households, if needed:** If paying upfront for panels is required, then alternative financing options should be provided. It should be noted that attaining financing is probably unrealistic for many low-income subscribers. To reach these subscribers consider a revolving fund, financial backing, green banks, or credit reserve fund. Here are some considerations if financing is considered:
    - The lender will need to provide (very) low interest loans.
    - The lender might also need to not require minimum income requirements or credit scores.
    - The lender should be comfortable lending very small amounts.
    - Because many times a household signs up for a project many months before they receive a benefit the loan will need to align with the start of the benefit.
    - The lender should be comfortable with a long-term agreement.
    - Include a clause that allows households to exit the loan if they leave the community solar program.
    - The lender might also look into earning redevelopment points, which are necessary to comply with the Community Reinvestment Act.

  Impact investing has become a very powerful tool for catalyzing investment in renewable energy and energy efficiency. While no examples were found in Colorado where impact investing was used to support community solar, there is potential for this mechanism to support future projects.

  In addition, on-bill financing helps overcome many of the aforementioned financing barriers.
- **Require that utility Renewable Energy Standard Adjustment (RESA) programs dedicate a portion of funds to support low-income solar installations:** The RESA is collected as a percentage of sales from IOU customers and may be used to pay for the incremental costs of renewable energy over traditional energy resources. As part of the program, IOU customers are required to pay a small fee to support utility renewable energy programs (e.g. Xcel Energy's RESA fund). Yet, a majority of these funds subsidize projects for non-low-income subscribers since it is these subscribers that are more likely able to afford the high capital cost of solar installations and/or receive financing. Require that utility companies dedicate a portion of these funds to support low-income specific solar installations.

  In several recent settlements, Colorado's IOUs ensured that some of the funding was allocated to low-income community

solar. This led to Xcel Energy allocating nearly 20 MW (18.75 community solar and 1.05 MW CEO rooftop pilot) of dedicated low-income community solar over three years and Black Hills allocating nearly 500 kW low-income community solar offering over three years. [36]

"We created a "solar endowment" to help improve the quality of life for those folks who need help paying for their utilities. We could have invested this money in the stock market, but we used it to create a solar project."

– Wiley Freeman, SMPA Manager of Member Services

- **Have utilities provide a mandated or non-mandated funding source:** Most of the utilities interviewed had a mandated or optional program in which ratepayers paid a little extra on their bill each month to help fund various programs including carbon reduction programs, local non-profits, and energy efficiency. The fees were calculated in various ways including: a "round-up" program where the bill is rounded up to the nearest dollar[37] , a flat monthly amount, or a percentage of the total bill. Some of these funds could be allocated to specifically fund low-income community solar programs.

  Other examples include alternative compliance, green funds, and local carbon taxes.

- **Provide incentives for community solar arrays to be located on brownfields:** Brownfields are lands that are too polluted for conventional uses and are left undeveloped. Many brownfields are found in or near low-income communities. These plots of land could be an ideal location for a large-scale solar array and if they are leased to the developers at a reduced rate the developers could pass along these savings to subscribers, specifically to low-income subscribers. Two of the Demonstration Projects were located next to or on a brownfield. While both projects noted that the land was cheaper there were additional permitting and building costs associated with building on a landfill. Funding in the form of grants and/or permitting support could help encourage more community solar on brownfields.

7.3 Contracting and Other Policy Considerations

The following is a list of policies that may increase the number of low-income households received community solar:

- **Mandate the 5 percent low-income carve-out for community solar across the state:** Currently, only IOUs (Xcel Energy and Black Hills Energy) are mandated to carve out 5 percent of their arrays for low income households. Note that Xcel Energy had a global settlement that restructured their 5 percent requirement into a utility-owned offering. Community solar legislation could be updated to require this carve-out for all community solar projects throughout Colorado.

  Note that this policy could result in less community solar arrays being built since many developers noted that they would have to provide the community solar for a loss (sometimes even for free). In addition, the 5 percent carve-out in IOU's has generally resulted in an artificial cap on the amount of low-income solar that is being allocated. In other words, developers will only do 5 percent, not more. On the flip side, some individuals would argue that the 5 percent carve-out is too low and should be increased to a higher rate.

- **Provide a preference for low-income participation in solar gardens in bids:** Instead of making the changes at the PUC or legislatively, the changes could be done by the utility. For example, one Colorado utility in their Renewable Energy Standard (RES) plan addressed the increase in low-income participation in two ways. First, they requested an acquisition process for solar gardens that "gives weight in the evaluation process to bids that propose to exceed the low-income set aside." Secondly, the utility allowed bidders to "propose higher subscribed REC prices for low-income subscribers and lower subscribed REC prices for other subscribers, as long as the average aggregate of all subscribed REC prices for the project meets the avoided cost cap for subscribed REC prices indicated in the RFP solicitation."[li] In return, low-income community solar was being encouraged for all projects.

  Other ways that bids could increase low-income impact is providing preference for projects with the highest percentage of electric bill savings for low-income households and/or the highest percentage of low-income customers.

- **Provide targeted support for siting:** Helping reduce the costs or speeding up the siting of low-income community solar projects would be greatly beneficial. Also, targeted preference in interconnection queues could also provide a significant benefit.

- **Add to the utilities mission statement/mandate to reduce costs for low-income households:** Several projects were supported by their utilities council or board of directors since their mandate or mission statement required them to reduce costs for low-income ratepayers.

[36] For more information see: http://hermes.cde.state.co.us/drupal/islandora/object/co%3A22033/datastream/OBJ/download/Renewable_energy_standard.pdf

[37] For example, see the Yampa Valley Electric Association Operation Round-Up program: https://www.yvea.com/content/operation-roundup

8. Conclusion

As with any new program or policy, there is a steep learning curve. While there were many lessons learned from the Demonstration Project, one thing was very clear - each of the 380 subscribers greatly benefited from the program and community solar could be an essential and replicable tool in reducing energy burden. Households saved 15 percent to over 50 percent on their utility bills with on average annual savings of $382. In addition, having a predictable energy bill was a significant benefit. As some households noted, this program enabled them to confidently pay their second highest bill after rent or their mortgage without sacrificing on other basic needs (i.e. groceries, healthcare). Many participating households also felt a great sense of pride in their community for having a low-income community solar program and were excited to be able to utilize solar for the first time.

For utilities, the results were mixed. While all the utilities earned a positive return on their community solar projects, the return was smaller than what they would have earned if they had continued charging their low-income subscribers the same retail rates. Even so, every utility interviewed remained positive with the program and were happy with the outcomes. This was largely due to the many qualitative benefits of the projects including (but not limited to): marketing benefits; meeting renewable energy goals and regulations; reducing costs for low-income households; reducing the risk of non-payments, and increasing their knowledge of solar procurement and ownership.

Even with the aforementioned benefits, only a few utilities considered doing another project in the near term. This was largely due to the lower financial returns than a business-as-usual scenario. Moving forward, the Demonstration Project provides many lessons learned that can be applied to programs and policies throughout the country that will help reduce the soft and hard costs of solar to make low-income community solar a replicable model for those across the state and across the country. For example, the financing best practices will help ensure that the utilities costs are lowered, while low-income households still receive a notable financial benefit. The programmatic best practices will help lower building, administration, and operational costs. The policy best practices will help policymakers, energy offices, and utilities create programs and policies that will encourage or mandate the inclusion of low-income households, while providing a lasting funding or financing resource to increase the number of projects.

By implementing the right combination of program best practices and policy improvements low-income subscribers will be better served, utilities will benefit, and the strength and sustainability of the community solar program will be improved.

The Demonstration Project makes clear that the ability for community solar to benefit low-income households is significant. With the declining cost of solar, there is increasing potential for all households to save money on their energy bills. And no one needs to save money more than low-income consumers, who are much more likely to be energy burdened. Moving forward, much like energy efficiency, community solar programs can and will provide an impactful and replicable tool for utilities, non-profits, developers, housing authorities, and governments to reduce energy burden.

9. Appendix A: Model Case Studies

Low-Income Community Solar Demonstration Project Case Study: Delta-Montrose Electric Association

SEPTEMBER 2017

COLORADO
Energy Office

Project Details

Delta-Montrose Electric Association's Demonstration Project Highlights

- When built in 2016, DMEA's low-income community solar garden was the largest of its kind in the country.
- DMEA's Board of Directors was motivated to create a local and resilient energy source for low-income members.
- On average, subscribers will realize annual cost savings of $312, and when combined with average cost savings of $200 from CEO's weatherization assistance program, subscribers could see annual savings of $512.

INTRODUCTION

Approximately 30 percent of Colorado households pay more than 4 percent of their annual income on energy bills. Although several financial assistance programs exist to relieve high energy burden for low-income households, additional opportunities remain to achieve deeper cost savings by specifically targeting reductions in electricity costs.

The Colorado Energy Office's (CEO) Weatherization Assistance Program (WAP) is dedicated to improving energy affordability for low-income households. Guided by this commitment and in response to a gap in electricity cost reduction programs, CEO launched the Low-Income Community Solar Demonstration Initiative in 2015. The Delta-Montrose Electric Association (DMEA) demonstration project is part of the statewide initiative that aims to reduce electricity costs for low-income households by offering community solar options to the same households that are eligible for weatherization services.

OBJECTIVE

The demonstration project has eight utility partners, including Delta-Montrose Electric Association, a rural electric co-operative utility serving Montrose, Delta, and Gunnison counties. This case study describes DMEA's community solar project and informs utilities, governments, and policy makers how community solar projects can impact low-income communities.

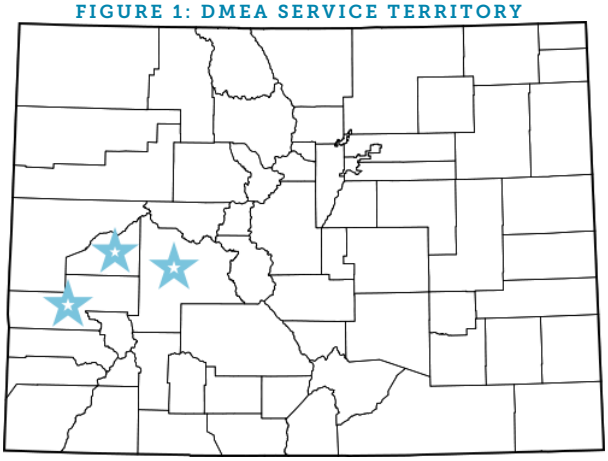
PROJECT PARTNER ROLES

DMEA partnered with CEO and GRID Alternatives (GRID) to develop a 151 (kilowatt) kW community solar array. The primary goal of the project was to provide a local and resilient energy source for up to 43 low-income co-operative members.

Each partner played a key role:

- CEO identified the demonstration project opportunity and provided funding support and project evaluation.
- GRID developed the design and implementation framework, designed and led the installation of a new 151 kW system, provided workforce integration and outreach, and managed subscriptions. In addition, GRID will conduct primary operation and maintenance (O&M) activities and maintain equipment warranties.
- DMEA provided funding support, provided the land and interconnection, and conducted outreach. In addition, DMEA will provide bill credits and billing support, maintain full ownership, and support O&M.

FIGURE 1: DMEA SERVICE TERRITORY



PROJECT IMPLEMENTATION

The project was first introduced to DMEA's Board of Directors in January 2016. It was approved because of its benefit to low-income members and its synergy with member values, including support for renewable energy and energy independence. The solar garden was interconnected with DMEA's grid in September 2016. The first subscriber signed up in November 2016, with 100 percent subscription achieved within one month. Subscribers began seeing cost savings in December 2016.

To qualify, subscribers must earn less than 80 percent of HUD's area median income (AMI). DMEA may refer subscribers and deny subscriptions due to poor credit

history, history of unpaid bills, and/or illegal activity. DMEA has committed to providing subscriptions for 20 years, with individual subscriptions lasting five years.

The project was implemented using a turn-key installation in a "barn-raising" community development model, where subscribers donated 16 hours of sweat equity and worked alongside GRID and DMEA. The panels were installed adjacent to DMEA's headquarters on land owned by DMEA, and the community solar production meter was interconnected directly to DMEA's electric grid. As an electric utility generation plant, DMEA's income-qualified community solar garden was exempt from the State Electrical Board's regulations on solar generation; therefore, no state electrical permit was required. The meter was interconnected to DMEA's electric grid because the array was too far from the building, and the extensive trenching and infrastructure changes proved to be too costly to net meter the array at DMEA's headquarters building on site.

ENERGY GENERATION

Much of DMEA's staff had little to no experience operating and maintaining renewable energy systems. DMEA trained staff and helped them understand their new role as a generation utility and the additional responsibilities that come with that role, such as advanced billing.

"Even with a diverse staff, we needed a perspective change. We need to get familiar with being a generation and transmission utility." Jim Heneghan, DMEA Renewable Energy Engineer

DMEA entered into a contractual relationship with DMEA's wholesale electricity provider, Tri-State Generation and Transmission Association, Inc. (Tri-State). Tri-State's Board of Directors' renewable energy policies 115 and 117 govern the contractual agreement between DMEA and Tri-State. Policy 115 governs the terms under which DMEA can develop "self-generation" and lists the bill credit rates paid by Tri-State to DMEA for the electricity generated by the community solar array and put on to the electric grid. Tri-State will provide bill credits to DMEA for the life of the five-year Policy 115 contract (which presumably will be renewed during DMEA's 20-year contract with GRID) and then will bill DMEA for the electricity produced by the community solar array. DMEA's wholesale electric contract also limits co-operative owned electricity generation system sizes to no more than 5 percent of the co-operative's total load.

Policy 117 lists the Renewable Energy Credit (REC) amount paid by Tri-State to DMEA for the environmental attributes (e.g. avoided greenhouse gas emissions) generated by the community solar array. Tri-State will purchase and retain ownership of the RECs throughout the five-year term of the Policy 117 contract. Tri-State will apply the RECs to their state Renewable Portfolio Standard requirements in which Tri-State is required by Senate Bill 13-252 to generate 20 percent of their electricity from renewable energy sources by 2020.

PROJECT COSTS

According to Jim Heneghan, DMEA's Renewable Energy Engineer, the project was completed at a lower cost than other solar projects presented to the utility. Yet, DMEA partially subsidized the project since they were required to pay wholesale electricity costs to Tri-State and substantial interconnection fees.

Tri-State's renewable energy policies require DMEA to pay Tri-State for electricity consumed by its members even though that consumption is offset by the community solar project. Interconnection costs were high because DMEA used a transformer with voltage control and incorporated Tri-State's specific metering equipment.

"The biggest hurdle was getting to a point where the cost to the utility and the benefit to the participant were both manageable." Jim Heneghan, DMEA Renewable Energy Engineer

CEO's grant was essential to making this project happen. Without CEO investment, DMEA would have had to extend the length of their internal loan or provide fewer savings to subscribers, which would have forced them to miss their target of 50 percent cost savings.

DMEA borrowed its contribution from an internal loan, and will repay the loan using money received from the subscriber's solar payment over the next 20 years.

The project cost $315,900, with $180,000 covered by CEO's grant and $135,900 contributed by DMEA. Direct project costs included operations (such as equipment, construction materials and GRID staff time), outreach, and administration. Operations accounted for approximately 96 percent of total project costs, while outreach and administration accounted

for approximately 1 percent and 3 percent of project costs, respectively. DMEA provided in-kind support including billing software, ongoing program administration, and the donation of land.

The total cost per watt was slightly lower than CEO's other low-income community solar demonstration projects since the array was larger than most other projects, which optimized economies of scale.

"The biggest advantage of most renewable energy sources is that it has high capital costs but low operating costs." – Jim Heneghan, DMEA Renewable Energy Engineer

PROJECT PRODUCTION

The estimated annual kilowatt hour (kWh) production of the solar garden was modeled using PVSyst, and the system's long-term degradation was assumed to equal 0.7 percent per year. In Year 1, the system is expected to produce 243,128 kWh. Actual production data from October 2016 through April 2017 shows that the system produced 127,650 kWh, while estimated production during that same period was 129,045.5 kWh. During this timeframe, the system produced 1 percent less electricity than expected. (Note: solar radiation was well below average during portions of December 2016 and January 2017.)

PROJECT OUTREACH

DMEA and GRID partnered to provide subscriber outreach using program brochures and through two in-person workshops. Each workshop discussed program and contract details and established expectations for system performance and cost savings. Both DMEA and subscribers reported successful outreach.

SUBSCRIBER STATISTICS

The 151 kW solar garden serves 43 subscribers, with each utilizing varying amounts of solar energy from the garden. System sizes range from 2.4 kW to 4.8 kW, with an average system size of 3.6 kW. Subscribers have a five-year contract with DMEA, and subscription contracts can be renewed. Systems are sized to offset approximately 50 percent of subscribers' electricity costs, based on the subscribers' previous 12-month electricity consumption.

COST STRUCTURE

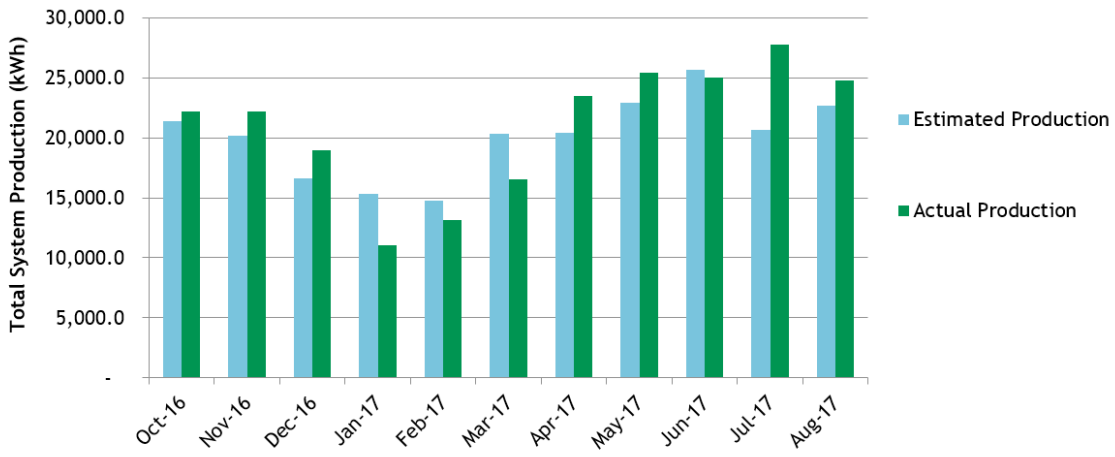
The subscriber pays DMEA the retail rate for electricity consumed plus fixed monthly charges. In return, DMEA provides a bill credit to subscribers for the electricity produced by their panels.

The 2017 residential retail rate is $0.1045 per kWh. Fixed charges include a monthly base charge, taxes, and a franchise fee (the franchise fee only applies to DMEA members who live in municipal areas that implement a franchise fee). The total fixed charges are approximately $32, whereas the monthly base charge is $25 and other fees are $7.

The bill credit is equal to $0.0645 per kWh and will increase as DMEA's residential rates increase. DMEA set the solar credit at a value slightly higher than what it receives as a bill credit from Tri-State; however, Tri-State's bill credit rate will increase over the five-year contract term and will be close to the solar credit that DMEA offers to its subscribers.

The difference between the retail rate and the bill credit is the solar payment, which DMEA will collect to pay off its internal loan. In 2017, it is set at $0.04 per kWh and will remain fixed for the term of the contract. The solar payment was set at a rate that would allow DMEA to repay its loan at 0 percent interest over a 20-year loan term. For subscribers, a constant and known solar payment provides insulation against rising electricity costs and helps subscribers budget for long-term energy costs.

FIGURE 2: ESTIMATED VERSUS ACTUAL SYSTEM PRODUCTION



"One of the greatest aspects of this program is locking in [electric] rates. The cost of electricity will be fixed even with inflation." Jim Heneghan, DMEA Renewable Energy Engineer

On average, DMEA's project is expected to save each subscriber approximately $312 each year. Assuming average annual electric utility costs of $1,250, based on DMEA's historic data, the community solar garden, when combined with potential cost reductions of $200 achieved through CEO's weatherization assistance program, could reduce low-income subscribers' annual energy costs by approximately 41 percent.

DMEA'S NEXT STEPS

Since DMEA's renewable energy growth is restricted by Tri-State's 5 percent co-operative-owned generation cap, and they are operating the community solar project at a loss, DMEA is not sure if they can or will pursue additional community solar projects. However, they are open to additional projects if the economics are favorable and the project could be exempt from Tri-State's generation cap.

Subscriber Spotlight: Steve and Sue Sidebottom

Steve and Sue Sidebottom were hit hard with the 2008 Recession and were looking for ways to save money. They signed up for DMEA's program November 2016, and expect to save 30 percent to 50 percent of electricity costs each year.

"It is a big thing to know what our bill costs will be for the next few years. It helps us with budgeting." Steve Sidebottom, Subscriber

Renewable energy has always been of interest. Yet, Steve was concerned with ongoing maintenance and siting challenges. A direct-owned rooftop system has always been too expensive.

Steve and Sue both attended workshops held by DMEA and GRID and volunteered at the solar installation event. Although outreach went smoothly, putting ink to paper was a bit more challenging. Steve and Sue noted that many were cautious of signing a new contract, and did not feel that outreach efforts adequately covered contractual requirements. However, they trusted DMEA and, therefore, put their trust in DMEA's community solar project.

"Once we signed up, it was easy. It was streamlined, and we had good customer service and good response time. DMEA was fabulous." – Sue Sidebottom, Subscriber

They noted that getting the word out in person or via newspapers or bill inserts was essential. Many of the members are older and do not use electronic devices and high-speed Internet is limited.

Estimated Versus Actual Performance

In the past 12 months, the Sidebottoms' household used 11,233 kWh and spent $1,460 on electric bills. To offset usage, the household was allocated 4.8 kW of solar energy.

DMEA SUBSCRIBERS: STEVE AND SUE SIDEBOTTOM

The solar system was expected to offset 64 percent of their usage and save 31 percent of their costs annually.

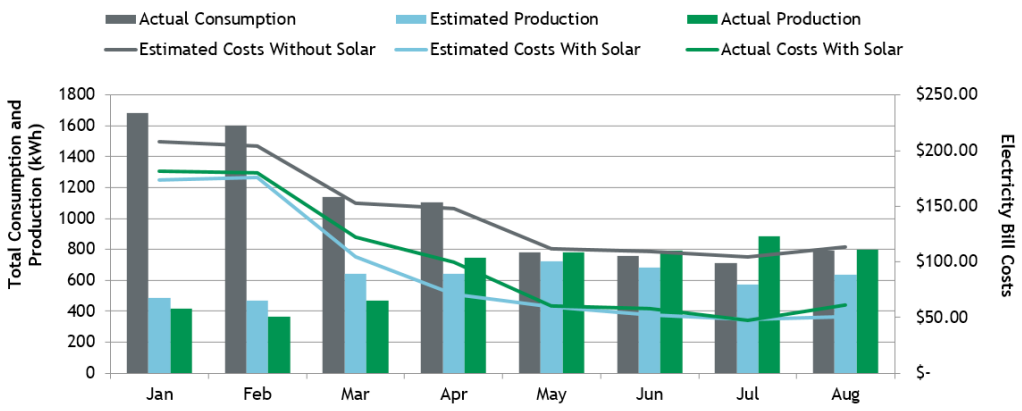
To date, the solar systems offset the Sidebottoms' usage by 61 percent and saved 31 percent of their electricity costs.

Utility data show that the Sidebottoms' consumption to date was slightly higher (around 1 percent) than it was during the same time last year, and their solar allocation produced 8 percent more electricity than expected to date.

Even if the solar array produces more electricity, subscriber costs will never be fully offset. Subscribers are required to pay a solar payment of $0.04 per kWh and fixed charges of approximately $25, which include a monthly base charge.

For example, the Sidebottoms' average annual consumption is 11,233 kWh and they spend on average $1,460. If their system were to produce 100 percent of their usage at 11,233 kWh, the Sidebottoms will be required to pay an annual solar payment of $449 (11,233 kWh at $0.04 per kWh) and 12 monthly charges of $300 (12 months at $25 each month) for a total annual payment of $749. In this example, the most that the Sidebottoms could save would be 49 percent.

FIGURE 3: ESTIMATED VERSUS ACTUAL SYSTEM PRODUCTION FOR THE SIDEBOTTOMS



Lessons Learned

SUCCESSES

- When it was built in 2016, this project was the largest community solar garden completely dedicated to low-income households in the country.
- The project has low operating costs and minimal O&M.
- The project aligned with DMEA's core values.
- Subscriber electricity costs were reduced.
- The project provided much needed renewable energy experience to DMEA staff members.
- Lower electricity costs will help reduce the number of non-payments that DMEA will receive.
- GRID's solar price was less than other solar models that were presented to DMEA.
- When coupled with CEO's weatherization assistance program savings, this project has the potential to reduce energy costs by approximately 51 percent.
- DMEA will use subscriber solar payments to pay back their internal loan.

CHALLENGES

- The project had a high capital cost.
- The biggest financial burden was the interconnection costs.
- As a Tri-State member, DMEA is limited by the 5 percent member-owned energy generation cap.
- Even with the CEO grant and GRID's support, it was difficult for DMEA to provide maximum benefit to subscribers while balancing utility costs.
- DMEA's staff had a lack of experience with installing renewable energy systems.
- It was difficult to set up new billing practices.

PROGRAM CONSIDERATIONS

DMEA's case study provides insight on how to optimize future low-income community solar garden projects.

Install the array on utility-owned land. Installing the array on land owned by the utility and adjacent to utility headquarters can simplify interconnection and help to save costs. Land that allows for a three-phase system will add system flexibility.

Focus on the benefits to the utility when marketing the project to the utility's Board of Directors. Utilities are more likely not to receive electricity bill payments from low-income households than from non-low-income households, and they may have to turn off electricity service as a result. This results in high administration costs and negative public relations. Reducing electricity costs for low-income households can reduce the number of non-payments received by the utility company, thereby reducing administration burden and avoiding negative public relations.

Consider in-person outreach methods. Many income-qualified households are older and may not have access to electronic outreach methods. Traditional outreach conducted through in-person workshops, newspaper announcements, and bill inserts may be more accessible to potential subscribers.

Research billing software in advance. New software, such as software that calculates and administers solar credits, may be difficult to master at first. Spend time researching software and training staff up front.

Educate utility staff about renewable energy generation, transmission, and distribution practices. Utility staff members may be new to renewable energy systems, and it is important that staff become familiar with new procedures and practices prior to administering a new community solar program.

Consider developing an internal loan program to finance a community solar project. If funds are not available, consider borrowing from internal reserves to develop and maintain a community solar project. The utility can pay back the internal load with solar payments provided by the subscribers.

POLICY CONSIDERATIONS

Lessons learned from the DMEA community solar garden present the following policy considerations:

Fixed charges play a significant role in the potential for reducing energy costs. Community solar incentives are typically provided as bill credits – credits on utility bills – and are issued as a dollar per kWh amount at a value less than retail rates. Fixed charges are not affected. While a subscriber's bill will be reduced by the bill credit amount, the subscriber will always be responsible for paying fixed charges. The degree to which a subscriber's energy costs are reduced is a direct function of the amount of fixed charges relative to the cost of electricity. In the DMEA's solar model, subscribers will be responsible for paying approximately 50 percent of the bill even when total electricity consumption is 100 percent offset by community solar.

Lessons Learned

Wholesale power purchase agreements affect a co-operative utility's ability to offer community solar. Where and how a co-operative utility purchases its power can greatly affect its ability to provide community solar. DMEA was limited in its ability to offer more community solar and to manage operating costs because of Tri-State's Board of Directors' renewable energy policies 115 and 117, which limit self-generation to 5 percent of total consumption and require that DMEA pay for the electricity consumed by its members that is offset by solar. In addition, Tri-State's renewable energy policies prohibit the community solar array from offsetting peak demand charges. If Tri-State had accepted peak demand offsets from DMEA, DMEA could have realized an additional few thousand dollars of savings each year.

The solar payment structure affects subscriber's total cost savings. The amount that each subscriber pays to participate in community solar and associated escalation rates affects the subscriber's total savings. DMEA solar payments do not escalate even though electricity costs do. Therefore, solar credits will grow over time and the subscriber's savings will stay relatively the same or slightly increase.

Project Snapshot

QUICK STATISTICS

- 151 kW solar garden
- Maximum 43 subscribers
- 100% subscribed
- Largest LMI community solar garden project in the nation
- 53% of current subscribers have received CEO's weatherization services, while another 39% qualify
- Uses Tri-State Board of Director's Renewable Energy Policies 115 and 117

UTILITY TYPE

- Rural electric co-operative
- Serves 12,000 members in Montrose, Delta, and Gunnison counties
- Receives wholesale electricity from Tri-State Generation and Transmission, Inc.

ENERGY BURDEN

- Approximately 18% of Montrose County, 16% of Delta County, and 13% of Gunnison County residents live below the poverty line, compared to a statewide average of 12%.
- For those living at 50% of the poverty line, Montrose County residents have an energy burden of 23%, Delta County residents have an energy burden of 23%, and Gunnison County residents have an energy burden of 27%.

PROJECT GOALS

1. Reduce members' energy costs by approximately 50%
2. Provide a local, resilient electricity source
3. Provide locked-in energy prices
4. Provide renewable energy and diversify energy supply
5. Enable DMEA staff to get hands-on experience

PROJECT PERFORMANCE

- Project target is approximately 50% cost savings
- Expected to produce 243,128 kWh annually
- Within four months, the system has produced 1 percent less electricity than expected

PROJECT COSTS

- Total project cost $315,900
- CEO grant $180,000
- DMEA contribution $135,900 plus in-kind support

SUBSCRIBER PAYMENT STRUCTURE

- Costs and credits for 2017:
  - Retail rate $0.1045/kWh 1
  - Monthly fixed charges ~$32
  - Solar credit rate $0.0645/kWh
  - Subscriber solar payment $0.04/kWh

Low-Income Community Solar Demonstration Project Case Study: Empire Electric Association

MARCH 2017

COLORADO
Energy Office

Project Details

Empire Electric Association's Demonstration Project Highlights

- The project's target of approximately 50 percent subscriber cost savings was achieved.
- CEO dollars revitalized EEA's stranded solar asset to benefit low-income members.
- CEO dollars helped create a low-income solar resource where none existed before and brought more solar to an area which is traditionally served by conventional energy sources.
- On average, subscribers will realize annual cost savings of $485. When combined with average cost savings of $200 from CEO's WAP, subscribers could see total annual savings of $685.
- The project helped further CEO's goal to reduce Colorado's low-income energy burden.

INTRODUCTION

Approximately 30 percent of Colorado households pay more than 4 percent of their annual income on energy bills. Although several financial assistance programs exist to relieve high energy burden for low-income households, opportunities remain to achieve deeper cost savings by specifically targeting reductions in electricity costs.

The Colorado Energy Office's (CEO) Weatherization Assistance Program (WAP) is committed to improving energy affordability for low-income households. Guided by this commitment and in response to a gap in electricity cost reduction programs, the CEO launched the Low-Income Community Solar Demonstration Project (Demonstration Project) in 2015. The Demonstration Project is a statewide initiative that aims to reduce electricity costs for low-income households by offering community solar options to the same households that are eligible for weatherization services.

OBJECTIVE

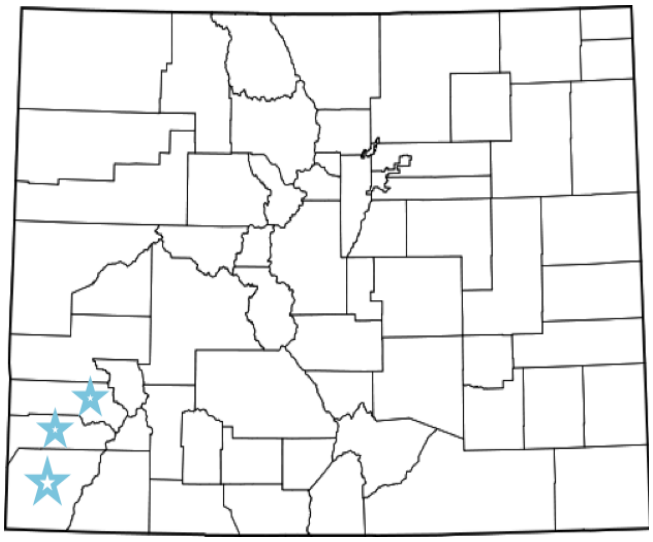
The Demonstration Project has eight utility partners, including Empire Electric Association (EEA), a rural electric co-operative utility serving Montezuma, Dolores, and San Miguel Counties. This case study describes EEA's community solar project and how it successfully reduced low-income energy burden.

The intent of this case study is to inform utilities, governments, and policy makers about how community solar projects can impact low-income communities.

PROJECT PARTNER ROLES

EEA partnered with the CEO and GRID Alternatives (GRID) to develop a 26 (kilowatt) kW community solar array for up to seven low-income co-operative members. The primary goal of this project was to positively impact the low-income community through more affordable electricity costs.

FIGURE 1: COUNTIES SERVED BY EEA'S SOLAR GARDEN



Each partner played a key role:

- CEO provided project evaluation and funding support.
- GRID provided the design and implementation framework, designed and installed a new 21 kW system, provided workforce integration, provided outreach, and managed subscriptions. In addition, GRID will conduct primary operation and maintenance (O&M) activities and maintain equipment warranties.
- EEA provided the land and interconnection, donated 5 kW of community solar generation from an existing garden, and conducted outreach. In addition, EEA will provide solar credits, bill support, maintain full ownership, and support O&M.

PROJECT IMPLEMENTATION

The project was first introduced to EEA's Board of Directors in January 2016. It was approved within one month, based

on its value to low-income members and the ability to leverage CEO's grant. In June 2016, the solar garden was interconnected and fully subscribed with a waiting list. Subscribers began seeing cost savings in July/August 2016.

To qualify, subscribers must make less than 80 percent of HUD's area median income (AMI). EEA may refer subscribers and deny subscriptions. Subscriptions may be denied due to poor credit history, history of unpaid bills, and/or illegal activity. EEA has committed to providing subscriptions for 20 years, with each subscription lasting five years.

The project was implemented using a turn-key installation in a "barn- raising" community development model, where subscribers donated 16 hours of sweat equity and worked alongside GRID and EEA. The panels were installed adjacent to EEA's headquarters on land owned by EEA. The meter was put on EEA's main meter using a "behind-the- meter" approach, where the solar production meter was installed on the customer's side.

ENERGY GENERATION

EEA noted that there was "no downside" and "no risk" to hosting the solar array due to very little monetary requirements and streamlined implementation. EEA was able to connect to their existing community solar garden, simplifying interconnection and associated costs. Since the panels were connected to an existing garden there was no additional permitting. Though all normal electrical permits were still required. EEA reported "very little O&M effort" with staff conducting visual checks once or twice per month.

"The whole project went smoothly, including design and implementation. GRID has good experience and good people." - Clint Rapier, EEA System Engineer

Tri-State Generation and Transmission Association, Inc. (Tri-State) provides wholesale electricity to EEA. Tri-State's Board of Directors' renewable energy policies were not applicable to this project because EEA used a "behind-the-meter" approach where the system was connected to the customer's side of an existing meter at EEA's headquarters. This approach was possible due to the garden's small size and was also simpler and more streamlined than going through Tri-State. Also, since the project did not go through the renewable energy policies, it was not subject to Tri-State's 5 percent cap on member-owned energy projects. Since this project required no financial transactions with Tri-State, EEA owns the Renewable Energy Credits (RECs).

PROJECT COSTS

The project cost $78,750 and was covered by CEO's grant. Direct project costs included operations, such as equipment, construction materials and GRID staff time, outreach and administration. Operations accounted for approximately 96 percent of total project costs, while outreach and administration accounted for approximately 1 percent and 3 percent of project costs, respectively. EEA provided $32,677 in leveraged funds that included EEA's donation of 5 kW of capacity from the existing array, land donation, and estimated O&M contribution.

Per EEA, CEO's grant was essential; without the grant, the project would not have been built. Its small size and strategic location enabled CEO grant dollars to cover project costs.

"The grant from CEO made the project make sense. We were able to leverage the grant with existing EEA resources to provide maximum benefit to our members." – Josh Dellinger, EEA General Manager

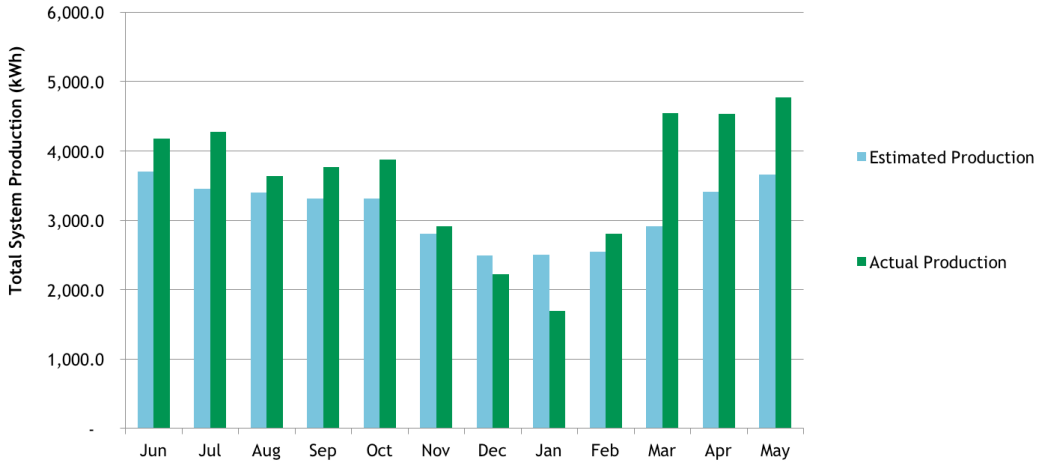
The total cost per watt was slightly higher than CEO's other low-income community solar demonstration projects since the array used a ballasted system and the capacity was small compared to the capital investment.

EEA will take on some costs over the duration of the program such as administration and O&M, but EEA has not and will not track these costs individually. These costs will be rolled into existing budget categories.

PROJECT PRODUCTION

The estimated annual kilowatt hour (kWh) production of the solar garden was modeled using PVSyst. Long-term degradation is assumed to equal 0.5 percent. In Year 1, the system is expected to produce 37,499 kWh. Actual production data from June 2016 through May 2017 shows that the system produced 43,225.1 kWh. During this timeframe, the system has produced 15 percent more electricity than expected.

FIGURE 2: ESTIMATED VERSUS ACTUAL SYSTEM PRODUCTION



Data was provided by EEA and assumes that 50% of production from the existing 10 kW system (5 kW was donated to the demonstration project) applies to low-income community garden.

PROJECT OUTREACH

EEA and GRID partnered to provide subscriber outreach using program brochures and through two in-person workshops. Each workshop discussed program and contract details and established expectations for system performance and cost savings.

Even with strong outreach, one subscriber stated that the program seemed "too good to be true" and the initial outreach did not discuss the program's funding sources. This was particularly concerning for older subscribers who are routinely the focus of various financial scams. Through multiple discussions during in-person workshops, many subscribers finally overcame their initial skepticism and signed up for the program. Despite some subscriber hesitation, EEA fully subscribed the garden and developed a waitlist. EEA was forced to limit the size of the garden due to available land space.

SUBSCRIBER STATISTICS

The 26 kW solar garden can serve seven subscribers, with each utilizing varying amounts of solar energy from the garden. System sizes range from 2.7 kW to 4.3 kW, with an average system size of 3.7 kW. Subscribers have a five-year contract with EEA, and subscription contracts can be renewed. Systems are sized to offset approximately 50 percent of subscribers' electric costs based on the subscribers' previous 12-month electricity consumption.

COST STRUCTURE

The subscriber pays EEA the retail rate for electricity consumed plus fixed monthly charges. Fixed charges include a grid access charge. The 2017 residential retail rate is $0.096 per kWh and the fixed monthly charge is $32.

Electricity generated by the solar array is metered behind EEA's office meter. In return, EEA provides a solar credit to subscribers for the electricity produced by their panels. This credit is currently equal to $0.072 per kWh and will increase as EEA's residential rates increase. Subscribers will pay EEA a solar payment of $0.024 per kWh, which is based on solar energy generated by the subscriber's panels and will remain fixed for the life of the contract.

On average, EEA's project is expected to save subscribers approximately $485 each year. Assuming average annual electric costs of $1,000, this community solar garden, when combined with potential cost reductions of $200 achieved through CEO's WAP, could reduce low-income subscribers' annual energy costs by approximately 69 percent.

EEA'S NEXT STEPS

Unless another grant becomes available, EEA has no plans to pursue another low-income community solar garden. While EEA believes that many of its members support renewable energy, a new renewable energy system could increase electricity costs and they do not believe that their members are willing to pay for it.

Subscriber Spotlight: Lloyd Gallion

Lloyd Gallion, an EEA community solar garden subscriber, lives with his family on a fixed income. He came across a brochure for EEA's community solar program and participated in a GRID/EEA sponsored outreach workshop.

"We are on social security. We didn't know how we would make it through this winter. This [program] was the answer." – Lloyd Gallion, Subscriber

Though it was difficult for Lloyd to believe that the program would play out as intended, he signed up and encouraged his friend to sign up as well. He could not be happier. Lloyd is saving money, relying on solar energy to power his home, and enjoying the fruits of his labor. As a subscriber to the system, Lloyd spent two rainy days installing panels alongside GRID staff, EEA staff, and fellow volunteers as part of GRID's barn-raising model, which uses volunteer labor to help install the systems.

EEA SUBSCRIBER: LLYOD GALLION

Estimated Versus Actual Performance

In the past, Lloyd's household used 6,526 kWh and spent $1,030 per year on electric bills. To offset usage, Lloyd's household was allocated 3.6 kW of solar energy.

Lloyd's solar system performance has exceeded expectations. The solar system was expected to offset 97 percent of his usage and save 45 percent of his costs annually. Lloyd's own analysis of utility bills shows that the expected values match initial predictions.

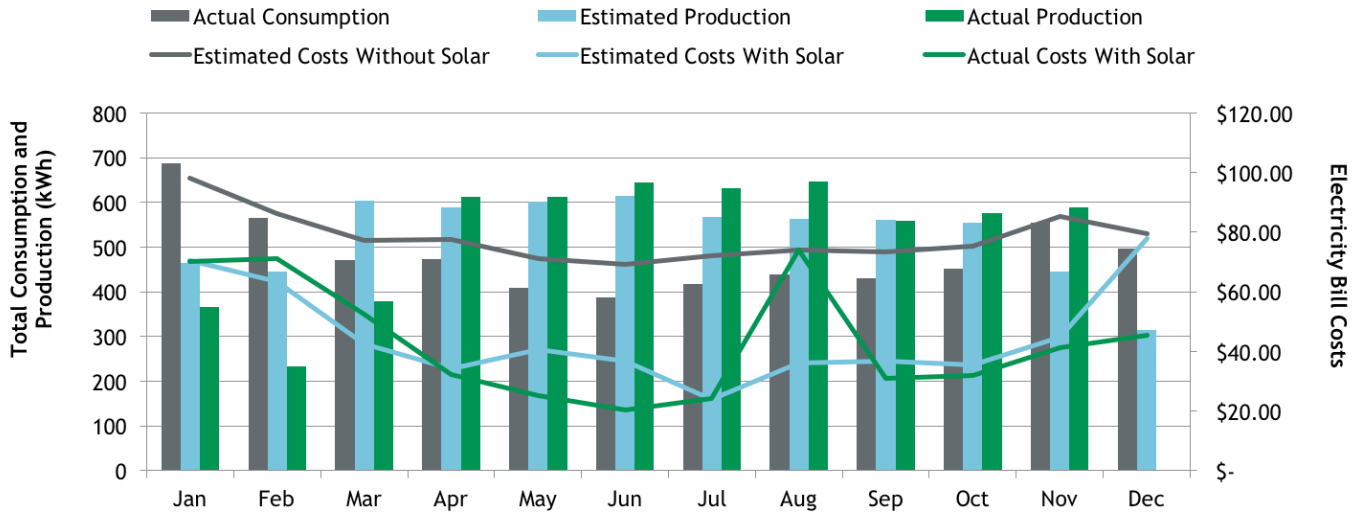
"This time of year our bills would be right around $100. [The solar garden] cut our bills down to $47 last month." – Lloyd Gallion, Subscriber

EEA's data verifies that the system is performing above and beyond expectations: to date, Lloyd's usage was offset 101 percent and he saved 45 percent of his electricity costs.

Even though Lloyd's usage has been offset by more than 100 percent, his costs will never be fully offset. Subscribers are required to pay a solar payment of $0.024 per kWh and fixed charges of approximately $32, which include a grid access charge.

For example, Lloyd's average annual consumption is 6,526 kWh and he spends on average $1,030. If his system were to produce 100 percent of his usage at 6,526 kWh, Lloyd will be required to pay an annual solar payment of $157 (6,526 kWh at $0.024 per kWh) and 12 monthly charges of $384 (12 months at $32 each month) for a total annual payment of $541. In this example, the most that Lloyd could save would be 47 percent.

FIGURE 3: ESTIMATED VERSUS ACTUAL SYSTEM PRODUCTION FOR LLOYD GALLION



Lessons Learned

SUCCESSES

- The low-income solar garden was easily interconnected with EEA's existing garden.
- This project had low risk since there was no capital cost and very low on-going costs.
- There were few O&M requirements.
- The time from approval to interconnection was relatively quick (six months).
- The garden was fully subscribed within one month.
- The subscribers had fun!
- Both the community and students were involved.
- The solar garden's production and savings exceeded expectations.
- When coupled with WAP savings, this project has the potential to reduce energy costs by approximately 70 percent.

CHALLENGES

- Many potential subscribers were skeptical.
- The garden's size was limited by available space.
- EEA was not willing to contribute funds and they will only pursue another project if they receive funding.
- A lot of residents could benefit from this program; however, participation is limited to seven subscribers.
- If "behind-the-meter" is not pursued, future gardens will be limited by Tri-State's 5 percent member-owned energy generation cap.

PROGRAM CONSIDERATIONS

EEA's case study provides insight on how to optimize future low-income community solar garden projects.

Design effective outreach. Consider the subscriber's perspective and conduct in-person outreach when possible. Outreach by word of mouth is a strong endorsement.

Promote transparency. Build subscriber trust through transparency and talk about the funding providers. Address skepticism by talking about common fears. If an organization(s) is making money or losing money on this project – talk about it.

For small gardens, consider a "behind-the-meter" installation and net-metering. The "behind-the-meter" approach avoided Tri-State's 5 percent member-owned energy generation cap and enabled retail net metering. A net metering structure can simplify billing and interconnection.

Focus on serving the low-income segment when marketing to the Board of Directors. The utility's Board of Directors may be motivated to support low-income members.

Connect the panels to an existing solar array. An expansion of an existing array does not result in additional permitting. However, the system is still subject to normal electric permits.

If space allows, size the system based on the number of subscribers. Size the system based on the potential number of subscribers and their collective electricity needs.

POLICY CONSIDERATIONS

Lessons learned from the EEA community solar garden present the following policy considerations.

Fixed charges play a significant role in the potential for reducing energy costs. Community solar incentives are typically provided as bill credits – credits on utility bills – and are issued as a dollar per kWh amount at a value less than retail rates. Fixed charges are not affected. While a subscriber's bill will be reduced by the bill credit amount, the subscriber will always be responsible for paying fixed charges. The degree to which a subscriber's energy costs are reduced is a direct function of the amount of fixed charges relative to the cost of electricity. In the EEA's solar model, subscribers will be responsible for paying approximately 50 percent of the bill even when total electricity consumption is 100 percent offset by community solar.

Community solar can leverage stranded solar assets. EEA had a community solar garden in place that was not fully utilized by co-op members. CEO's grant leveraged the stranded asset and made it useful to the low-income community.

Wholesale power purchase agreements affect a co-operative utility's ability to offer community solar. Where and how a co-operative utility purchases its power can greatly affect its ability to provide community solar. EEA's solar garden was installed "behind-the-meter" and was net metered, which both simplified the process and avoided financial transactions with Tri-State and Tri-State's 5 percent member-owned energy generation cap.

The solar payment structure affects subscriber's total cost savings. The amount that each subscriber pays to participate in community solar and associated escalation rates affect the subscriber's total savings. EEA solar payments do not escalate even though electricity costs do. Therefore, bill credits will grow over time and the subscriber's savings will stay relatively the same or slightly increase.

Project Snapshot

QUICK STATISTICS

- 26 kW solar garden, including 5 kW from an existing array and 21 kW from the new array
- Merged with existing 5 kW stranded solar asset
- Maximum 7 subscribers
- 100% subscribed with waiting list
- All subscribers are eligible for WAP

UTILITY TYPE

- Rural electric co-operative
- Serves 12,000 members in Montezuma, Dolores , and San Miguel Counties
- Receives wholesale electricity from Tri-State Generation and Transmission, Inc.

ENERGY BURDEN

- Approximately 19% of Montezuma County, 15% of Dolores County, and 11% of San Miguel County residents live below the poverty line, compared to a statewide average of 12%.
- For those living at 50% of the poverty line, Montezuma County residents have an energy burden of 25%, Dolores County residents have an energy burden of 27%, and San Miguel County residents have an energy burden of 26%.

PROJECT GOALS

1. Provide benefit to low-income members
2. Leverage financial investment from CEO

PROJECT PERFORMANCE

- Project target is approximately 50% cost savings
- Expected to produce 37,499 kWh annually
- To date, the system has produced 11% more electricity than expected

PROJECT COSTS

- Total project cost $78,750
- CEO grant $78,750
- EEA leveraged funds $32,677

SUBSCRIBER PAYMENT STRUCTURE

- Costs and credits for 2017:
  - Retail rate $0.096/kWh
  - Monthly fixed charges ~$33
  - Solar credit rate $0.072/kWh
  - Subscriber solar payment $0.024/kWh

Low-Income Community Solar Demonstration Project Case Study: Fort Collins Utilities

OCTOBER 2017

COLORADO
Energy Office

Project Details

Fort Collins Utilities' Demonstration Project Highlights

- The Solar Affordability Program (SAP) is the first Fort Collins program to bring together solar energy, energy efficiency, education and financial assistance into one structure.
- Community solar bill benefit is tied to commitment from customers to participate in a structured energy efficiency and education process to ensure that energy savings are permanent. The program aligns customer and home types with available no or low-cost efficiency options.
- Subscribers will only be able to receive benefits for one year to ensure that the maximum level of different household's benefit from community solar within the 25-year timeline.
- Project focuses first on households with electric heat.
- Colorado's first rooftop community solar project dedicated to serving income-qualified residents

INTRODUCTION

Approximately 30 percent of Colorado households pay more than 4 percent of their annual income on energy bills. Although several financial assistance programs exist to relieve high energy burden for low-income households, additional opportunities remain to achieve deeper cost savings by specifically targeting reductions in electricity costs.

The Colorado Energy Office's (CEO) Weatherization Assistance Program (WAP) is committed to improving energy affordability for low-income households. Guided by this commitment and in response to a gap in electricity cost reduction programs, the CEO launched the Low-Income Community Solar Demonstration Project (Demonstration Project) in 2015. The Demonstration Project is a statewide initiative that aims to reduce electricity costs for low-income households by offering community solar options to households that are eligible for weatherization services.

OBJECTIVE

The Demonstration Project has eight utility partners, including the City of Fort Collins Utilities (Utilities), a municipal utility that provides electric, water, wastewater, and stormwater services for over 70,000 City of Fort Collins residences and businesses. This case study describes the Solar Affordability Program which blends the benefits of community solar and a customized energy efficiency program to ensure that subscribers permanently reduce their electricity expense and usage.

PROJECT PARTNER ROLES

Fort Collins Utilities partnered with the CEO and GRID Alternatives (GRID) to develop a 64 (kilowatt) kW community solar array for up to 25 income and heating payment assistance qualified electric utility customers. In addition, the utility is drawing on the efficiency and conservation programs of Larimer County, Energy Outreach Colorado, and CEO WAP program to ensure that mobile, single-family, and multi-family households have customizable energy efficiency education and upgrades. By combining community solar and energy efficiency, the utility believes it will be able to provide permanent energy and cost savings to subscribers.

Each partner played a key role and will continue to play a key role moving forward:

- CEO provided project evaluation and funding support. Moving forward, the CEO WAP program will provide energy efficiency upgrades to qualified households.
- GRID provided the design and implementation framework, designed and lead the installation of the PV system, provided workforce integration, and planned a large kick-off event ("Solarthon") with Governor John Hickenlooper. Moving forward GRID will conduct primary operation and maintenance

(O&M) activities and maintain equipment warranties.

- The Utility provided funding support, the rooftop and interconnection materials, conducted outreach, and managed subscriptions. Moving forward Fort Collins Utilities will provide solar credits and billing support, maintain full ownership, and support O&M.
- Larimer County's Low-Income Energy Assistance Program (LEAP) will provide an annual list of income-qualified residents that are eligible to receive heating bill financial assistance in the utilities region.
- Larimer County Conservation Corp Energy and Water Program, Efficiency Works Home, Consumer Products rebates, and Energy Outreach Colorado programs will provide energy efficiency education, upgrades, and/or funding to qualified households and help them navigate at optimal path through available offerings.

PROJECT IMPLEMENTATION

Since 1982, the utility has created innovative energy efficiency programs that generate significant economic and environmental benefits to the region. In addition, Utilities was the first in the state and one of the first in the nation to offer customers the option to purchase clean, renewable wind power in 1998. The programs have evolved into several official energy efficiency, renewable energy, and greenhouse gas policies. In 2014, Fort Collins City Council adopted aggressive GHG reduction goals:

- 20 percent below 2005 levels by 2020
- 80 percent below 2005 levels by 2030
- 100 percent below 2005 levels by 2050 (carbon neutral)

"Fort Collins Utilities has a long-running history of local support for renewable energy technology – like the Wind Pioneers Program that helped make community wind shares a reality in 1998- strong expansion of rooftop solar, community shared solar programs, and large commercial and institutional solar projects. Our current project, a shared solar array to provide both job-training opportunities and long-term benefits to low-income households, is a perfect example of a project that will deliver environmental, economic and social equity benefits to Fort Collins."
– Kevin Gertig, Fort Collins Utilities Executive Director

In addition, Fort Collins Utilities has an energy policy that requires that their grid consists of 20 percent renewable

energy by 2020, be 80 percent below 2005 carbon emissions by 2030, and 100 percent carbon-neutral by 2050. Alongside these goals, Fort Collins Utilities supports continuous energy use reduction in all buildings types. As a percentage of community electricity use, Fort Collins Utilities hopes to achieve incremental annual electric portfolio savings of efficiency and conservation program savings of 1.5 percent by 2015, 1.75 percent 2016/17, and 2 percent by 2018/19, and 2.5 percent by 2020.[1]

In 2014, Fort Collins Utilities proposed working with local housing authorities to identify the best solar options (i.e. community solar or rooftop PV) to reduce costs in their 2015 budgeting cycle. While researching the best option, GRID and the CEO approached them about the Demonstration Project. Since the project met multiple goals of increased renewable generation and supporting low-income households and Fort Collins Utilities had a very strong response with a community solar array built by the Community Energy Collective, they decided to move forward.

Even with dedicated support, Fort Collins Utilities struggled with the best way to structure the community solar project. Since the community solar is considered an Fort Collins Utilities generation asset there were concerns that the project must benefit all Fort Collins Utilities ratepayers. To work with this requirement, Fort Collins Utilities structured the Solar Affordability Program to require subscribers to participate in conservation education and efficiency opportunities. To qualify, subscribers had to qualify for LEAP benefits (income up to 165 percent of the federal poverty level index). By working with LEAP, Fort Collins Utilities did not have to worry about finding a way to income-qualify ratepayers.

In February 2017, the Solar Affordability Program passed first reading to City Council and final reading one month later. The community solar array was interconnected into Fort Collins Utilities' grid in March. Participants were selected in June to match with the LEAP program cycle which ends every year on April 30th. The first subscriber signed up in June 2017 with 100 percent subscriptions achieved within the month. Subscribers received their first financial benefit in July.

The project was implemented using a turn-key installation in a "barn-raising" community development model, where

1 For more information see: https://www.fcgov.com/utilities/img/site_specific/uploads/Fort_Collins_2015_Energy_Policy_1.pdf

subscribers donated 16 hours of sweat equity and worked alongside GRID and Fort Collins Utilities. The panels were installed on a building owned by the City of Fort Collins warehouse at 518 N. Loomis Ave.

ENERGY GENERATION

Fort Collins Utilities has committed to providing the benefit of community solar for 25 years. During that time, they expect the array to produce around 2,005 MWh. During the first 6 (summer) months of system operation nearly 9,000 kWh were produced per month. The estimated impact for each subscriber is a reduced energy costs of around $35 per month during those summer months.

The City of Fort Collins self-generation is limited to a maximum of 1 percent of the community peak demand through an all requirements contract with Platte River Power Authority. However, even with the addition of this project renewable energy produced by the City of Fort Collins is well under the 1 percent. As a result, this was not an issue for this project.

PROJECT COSTS

The project cost $195,000, with $65,000 covered by CEO's grant and $130,000 contributed by Fort Collins Utilities as cash-upfront. Direct project costs included operations (such as equipment, construction materials and GRID staff time), outreach, and administration. Operations accounted for approximately 96 percent of total project costs, while outreach and administration accounted for approximately 1 percent and 3 percent of project costs, respectively. Fort Collins Utilities provided in-kind support including billing software, ongoing program administration, and the donation of a rooftop.

Since Fort Collins Utilities is limiting program participants to one year of benefits there will be higher overhead costs for recruitment and contracting since the Solar Affordability Program will benefit hundreds of households over the life of the program.

"Fort Collins Utilities decided to provide the customer management, instead of GRID, since we are very capable of doing this and conceptually we are in the best place to manage an ongoing process"
– John Phelan, Energy Services Manager at City of Fort Collins

PROJECT PRODUCTION

The estimated annual kilowatt hour (kWh) production of the solar garden was modeled using PVSyst. Long-term degradation is assumed to equal 0.7 percent per year. In Year 1, the system is expected to produce 87,181 kWh.

Actual production data from April 2017 through September 2017 shows that the system produced 53,500 kWh, while estimated production during that same period was 58,004 kWh. During this timeframe, the system has produced 7.8 percent less electricity than expected.

PROJECT OUTREACH

Fort Collins Utilities led subscriber outreach by informing local agencies of the program, performing information tabling events, and by mailing its 226 LEAP customers a prequalification letter and program application. They had an approximately 10 percent response rate, allowing them to accept all eligible customers into the program. In future years if number of applications is greater than the number of subscriptions available, Fort Collins Utilities will conduct a lottery to select participants.

"Fort Collins Utilities intent is to work with various household's and ownership types such as mobile, single-family, multi-family, owners and renters to better understand how we can better address energy costs for different groups."
–John Phelan, Energy Services Manager at City of Fort Collins

SUBSCRIBER STATISTICS

The 64kW solar garden will serve between 20 and 30 subscribers, with each household receiving an equal share of solar energy from the garden. All subscribers use

electric heat; therefore, their electricity usage is higher than households that utilize natural gas and/or propane for heat. Systems are sized to offset approximately 50 percent of subscribers' electricity costs based on the subscribers' previous 12-month electricity consumption. Subscribers are limited to a 1-year benefit with Fort Collins Utilities.

COST STRUCTURE

The subscriber pays SMPA the retail rate for electricity The subscriber pays Fort Collins Utilities the retail rate for electricity consumed plus fixed monthly charges. By participating in the SAP, Fort Collins Utilities provides a bill credit to subscribers for their share of the electricity produced by the system.

The 2017 base residential retail rate is $0.09733 per kWh and is expected to continue to increase over time. The bill credit is the same as that provided to Fort Collins market rate community solar project, currently at $0.0762 per kWh. The solar payment will increase annually for the term of the contract at the same percentage as the standard residential rate.

This model provides subscribers insulation against rising electricity costs and helps subscribers budget for long-term energy costs. In addition, subscribers can carry credits forward month to month through the end of subscription period or the credits may offset other elements of the combined Fort Collins Utilities bill (water, wastewater and stormwater).

Using 2016 usage numbers, the Fort Collins Utilities' project would be expected to save a total of $6,643 for all subscribers (~$300 per household). Assuming an average annual electric cost of $900, subscribers will save on average 33 percent. In addition, Fort Collins Utilities has committed to encourage non-weatherized households participating in the program to reduce electricity use through the CEO WAP program, Energy Outreach Colorado program Colorado's Affordable Residential Energy, and the Larimer County Conservation Corps Water and Energy program. Therefore, the impact could be much greater than 33 percent.

FORT COLLINS UTILITIES' NEXT STEPS

The City of Fort Collins Climate Action Plan[2] has set the following renewable energy goals for Fort Collins Utilities:

- Reduce the carbon intensity of utility-scale electricity by 80 percent by 2030 (compared to 2005 level).
- Ensure that by 2030, 50 percent of new construction will have enough solar PV to achieve net zero energy use.
- By 2030, ensure that 22 percent of existing homes and 50 percent of existing businesses have installed solar.

To aim for these targets, Fort Collins Utilities has committed to a drastic increase in community solar, utility-scale solar, and rooftop solar. Fort Collins Utilities is currently partnering with Platte River Power Authority to provide community solar with the other member cities of Estes Park Light and Power, Longmont Power and Communications, and Loveland Water and Power for 5 MW of solar. Since there are few places in Fort Collins where ground-mounted solar is the best use of land, this next community solar project will be located at the Rawhide Energy Station.

In addition, in the next year Fort Collins Utilities will provide grants to two housing authorities – Habitat for Humanity and CARE Housing- to complete 40 kilowatts of rooftop solar projects for income-qualified residents.

2 For more information see: http://www.fcgov.com/environmentalservices/pdf/cap-framework-2015.pdf

Subscriber Spotlight: Laura Wilson

Laura Wilson has been a Fort Collins resident since 1989 and lives in a tri-level single-family home. Laura is always looking for ways to save costs for her household including one of her household's largest costs – electricity. Even though she has already aggressively pursued electricity savings by weatherizing her home through the Colorado Energy Office Weatherization Assistance Program, Laura's electricity bills still average $180 per month. The house only uses electricity since they use electric baseboards for heat.

When Laura received a letter notifying she was prequalified for Fort Collins Utilities Solar Affordability Program she quickly jumped at the opportunity.

"I am all in with renewable energy and I love supporting this program. Having the ability to participate in a program like this, I couldn't imagine not signing up."
– Laura Wilson, Subscriber

Signing up for the program only took Laura a few minutes to fill in the form. She also attended an orientation session that outlined the program in greater depth. As part of the requirement of participating in the program Laura committed to completing four milestones. Due to Laura's previous experience weatherizing her home, she could already check off the first milestone. Through the Colorado Energy Office Weatherization Assistance Program, Laura replaced her refrigerator and lightbulbs, had pipes wrapped, and insulation installed. In return, her bills were notably reduced.

"Efficiency already made an enormous difference for costs and comfort. My house is tri-level so there was a significant difference in temperature from floor to floor. During the winter, with baseboard electric heat, my first floor was warm while the top floor cold. In the summer, it is the opposite. Weatherization significantly helped reduce this temperature difference."
– Laura Wilson, Subscriber

As part of the Solar Affordability Program, Laura completed an additional free energy audit. To reach the second milestone, Laura will need to attend an energy conservation activity, such as supporting a GRID installation or attending a "nuts and bolts" energy workshop that highlights energy efficiency upgrades and behavioral changes. To reach her third and fourth milestones, she will have to attend an additional energy conservation activity, get a Larimer County Conservation Corps Water and Energy Assessment, and complete a final progress report.

Once Laura was approved she started receiving benefits immediately. Currently she estimates that she saves an average of $30 every month on her utility bills and expects to save over $360 in utility costs during her time in the program.

"I will be sad when the program is over, but I hope the efficiency work will keep my bills down as much as possible."
– Laura Wilson, Subscriber

Lessons Learned

SUCCESSES

- The project has low operating costs and minimal O&M.
- The project aligns with Fort Collins Utilities' core values of increasing affordability for low-income customers and increasing the amount of renewable energy on the grid.
- Subscriber electricity costs were reduced.
- When coupled with efficiency and conservation savings, this project has the potential to reduce energy costs by over 33%.
- Increases the number of low-income households pursuing energy efficiency.

CHALLENGES

- Finding a location for the system.
- Without the CEO grant, the project would have been substantially smaller and less cost effective for Utilities Fort Collins Utilities.
- The program took considerable time to set up due to formalizing city council approval.
- The program will take some oversight to ensure that participants participate in energy efficiency.
- Since each household is limited to one-year benefit the program will have to do outreach every year.

PROGRAM CONSIDERATIONS

Fort Collins Utilities' case study provides insight on how to optimize future low-income community solar garden projects.

Make the connection between energy efficiency, conservation and savings. Subscribers are required to pursue energy efficiency programs and take part in education opportunities. Fort Collins Utilities hopes that by taking advantage of energy efficiency programs, subscribers will still experience utility cost savings, once they are termed out after one-year from the community solar program.

Partner with established community organization that work with low-income community. Fort Collins Utilities partnered with Larimer County's Low-Income Energy Assistance Program (LEAP), Larimer County Conservation Corp Energy and Water Program, Efficiency Works Home, Consumer Products rebates, and Energy Outreach Colorado programs to provide energy efficiency education, upgrades, and/or funding to qualified households and help them navigate at optimal path through available offerings. These organizations are trusted by low-income communities and enable easier, targeted marketing. In addition, the partners provide energy efficiency upgrades at a low cost.

Install the array on city-owned property. Installing the array on a city-owned warehouse can simplify interconnection and reduce costs.

Set a realistic expectation of savings. Fort Collins Utilities believes that you must provide a realistic expectation of cost savings from the program upfront to ensure the subscribers don't expect larger savings they receive.

Align the number of participants with the amount of solar and minimize length of participation. Due to the small size of the array, Fort Collins Utilities put a cap on the number of participants. By keeping the distribution small, more households can benefit. In addition, Fort Collins Utilities limited each household benefit to one year.

POLICY CONSIDERATIONS

Lessons learned from the Fort Collins Utilities community solar garden present the following policy considerations.

Require energy efficiency. Since the community solar is considered an Fort Collins Utilities generation asset there were concerns that the project must benefit all Fort Collins Utilities ratepayers. In order to work with this requirement, Fort Collins Utilities structured the Solar Affordability Program to require subscribers to participate in conservation education and efficiency opportunities which do benefit all Fort Collins Utilities ratepayers. In addition, energy efficiency ensures that households will achieve lower costs on their utility bills even when they are no longer receiving the community solar benefit.

Fixed charges play a significant role in the potential for reducing energy costs. Community solar incentives are typically provided as bill credits – credits on utility bills – and are issued as a dollar per kWh amount at a value less than retail rates. Fixed charges are not affected. While a subscriber's bill will be reduced by the bill credit amount, the subscriber will always be responsible for paying fixed charges. The degree to which a subscriber's energy costs are reduced is a direct function of the amount of fixed charges relative to the cost of electricity. In the Fort Collins Utilities' solar model, subscribers have a very low monthly fixed cost of $6.14. If the fixed costs do not completely cover the costs to serve a customer and the community solar program offsets all electricity costs, then the additional costs that are not covered to serve that subscriber will potentially be covered by non-participating members. On the flip side, low monthly fixed costs may disincentive utility from moving forward with a similar program due to a lower return-on-investment of a project.

Project Snapshot

QUICK STATISTICS

- 64 kW solar garden
- Maximum 25 subscribers
- 100% subscribed
- 100% of subscribers have received LEAP benefits and utilize electric heat

UTILITY TYPE

- Municipality
- Serves 70,500 homes and businesses members in Fort Collins area
- Receives wholesale electricity from Platte River Power Authority

ENERGY BURDEN

- Approximately 18.6% of City of Fort Collins Utilities live below the poverty line, compared to a statewide average of 12%.

PROJECT GOALS

1. Reduce members' electricity costs for households with electric heat
2. Provide a local, resilient electricity source
3. Provide locked-in energy prices
4. Provide renewable energy and diversify energy supply

PROJECT PERFORMANCE

- Project target is approximately 50% cost savings
- Expected to produce 87,181 kWh annually
- To date, the system has produced 7% less electricity than predicted by Developer Grid Alternatives

PROJECT COSTS

- Total project cost $195,000
- CEO grant $65,000
- Fort Collins Utilities contribution $130,000 plus in-kind support

SUBSCRIBER PAYMENT STRUCTURE

- Costs and credits for 2017:
  - Average retail rate $0.09733/kWh
  - Monthly fixed charges ~$6.14
  - Solar credit rate $0.0762/kWh

Low-Income Community Solar Demonstration Project Case Study:

Grand Valley Power

OCTOBER 2017

COLORADO
Energy Office

Project Details

Grand Valley Power's Demonstration Project Highlights

- GVP built the first low-income community solar garden in the country in 2015.
- GVP's project was the fifth phase of a larger community solar array.
- GVP invited the local weatherization administrator to be part of the project and allowed their clients priority enrollment.
- On average, subscribers will realize annual cost savings of $590, and when combined with average cost savings of $200 from CEO's Weatherization Assistance Program, subscribers could see annual savings of $790.

INTRODUCTION

Approximately 30 percent of Colorado households pay more than 4 percent of their annual income on energy bills. Although several financial assistance programs exist to relieve high energy burden for low-income households, additional opportunities remain to achieve deeper cost savings by specifically targeting reductions in electricity costs.

The Colorado Energy Office's Weatherization Assistance Program (WAP) is dedicated to improving energy affordability for low-income households. Guided by this commitment and in response to a gap in electricity cost reduction programs, CEO launched the Low-Income Community Solar Demonstration Initiative in 2015 (Demonstration Project). The Grand Valley Power (GVP) solar installation is part of the statewide initiative that aims to reduce electricity costs for low-income households by offering community solar options to the same households that are eligible for weatherization services.

OBJECTIVE

The demonstration project has eight utility partners, including Grand Valley Power (GVP), an electric co-operative utility serving 18,000 meters in Mesa, Delta, and Garfield counties. This case study describes GVP's community solar project and informs utilities, governments, and policy makers how community solar projects can impact low-income communities.

PROJECT PARTNER ROLES

GVP partnered with CEO, GRID Alternatives (GRID), and Housing Resources of Western Colorado (HRWC) to develop a 36.54 kW (kilowatt) community solar array. The primary goals of the project were to grow existing low-income community solar offerings and to expand services to low-income co-operative members. This project was the fifth installment of a larger community solar array that was first implemented in 2011. Each installment or "phase" was so

successful that GVP continued to build more capacity.

Each partner played a key role:

- CEO identified the solar installation opportunity and provided funding support and project evaluation.
- GRID developed the design and implementation framework, designed and led the installation of a new 36.54 kW system, provided workforce integration and outreach, managed subscriptions, and assisted with additional fundraising activities. In addition, GRID will conduct primary operation and maintenance (O&M) activities and maintain equipment warranties.
- HRWC administers CEO's weatherization program. They provided a NeighborWorks grant of $30,000 to support the project and, in exchange, their clients have priority enrollment.
- GVP provided funding support, the land and interconnection, and conducted outreach. Moving forward, GVP will provide bill credits and billing support, maintain full ownership, and support O&M.

PROJECT IMPLEMENTATION

GVP's total community array is 157.36 kW and consists of five phases. Phase 1 (20.68 kW) was built in 2011 and was available to all co-operative members. Phases 2 through 4 (100.14 kW total) were built in 2015 and are available to income qualifying members only. Phase 5 was the only portion supported by the CEO. It was built in 2017 and is only available to income qualifying members. GRID also partnered with GVP on Phases 2 through 5.

The project (i.e., Phase 5) was first introduced to GVP's Board of Directors in January 2017. It was approved within one month because of its benefit to low-income members. The Board was also motivated to support this project because previous community solar phases were very successful and helped build a good working relationship between GVP and its members. Construction began in March 2017, and the solar garden was interconnected in April 2017. The first subscriber signed up in October 2017. They are expected to see savings within one month.

As a utility, GVP has always looked for ways to offer rebate programs for its members. Unfortunately, most low-income households are not typically able to take advantage of existing rebate programs because those programs frequently require upfront capital. GVP's Board was excited to grow a line of services that are specifically available to low-income households, closing the gap in electricity service offerings.

"This project was an easy sell to our Board. There is no magic pot of money for rebate programs; they are always supported by all of our rate payers. Low-income households get left behind because they can't pay out of pocket and, because many households rent, they may not benefit from rooftop solar. Here's a program that finally serves these members."
-Derek Elder, GVP Member Service Manager

To qualify, subscribers must earn less than 80 percent of HUD's area median income (AMI). GVP may refer subscribers and deny subscriptions due to poor credit history, history of unpaid bills, and/or illegal activity. GVP has committed to providing subscriptions for 20 years, with individual subscriptions lasting four years. Subscribers can re-enroll if they still need financial assistance. GVP hopes that, over time, some subscribers' financial need will diminish and the array will become available to additional members.

The project was implemented using a turn-key installation in a "barn-raising" community development model, where volunteers donated 16 hours of sweat equity and worked alongside GRID and GVP. Typically, under GRID's implementation framework, utilities require that subscribers donate sweat equity to help construct the array. However, GVP's project was overwhelmed with volunteers from GVP's Board of Directors, GVP staff members, and students from the nearby Colorado Mountain College at Rifle; therefore, GVP waived the sweat equity requirement.

The panels were installed on land owned by GVP about 10 minutes away from GVP's headquarters. The community solar production meter was interconnected to GVP's electric grid. As an electric utility generation plant, GVP's income qualified community solar garden was exempt from the State Electrical Board's regulations on solar generation; therefore, no state electrical permit was required.

ENERGY GENERATION

Since the array is less than 80 mega-watts (MW) it is a qualifying facility under the Public Utilities Regulatory Act (PURPA). As a PURPA qualifying facility, GVP must adhere to PURPA rules and its wholesale contract with Xcel Energy (Xcel). Because of the small size, GVP stated that Xcel provided GVP full autonomy in the array's design and implementation.

GVP has three different oversized electricity transformers at the site. If the voltage gets too high, one or more of the inverters could be shut off. GVP has to carefully manage voltage of the arrays and this has proven to be challenging to GVP.

PROJECT COSTS

The project cost $55,250, with $21,250 covered by CEO's grant and $34,000 contributed by GVP of which $30,000 was provided by HRWC's NeighborWorks grant and the remaining $4,000 was provided by GRID. Direct project costs included operations (such as equipment, construction materials and GRID staff time), outreach, and administration.

Operations accounted for approximately 96 percent of total project costs, while outreach and administration accounted for approximately 1 percent and 3 percent of project costs, respectively. GVP provided in-kind support including billing software, ongoing program administration, and the donation of land. GVP is not tracking administration costs.

Additional project funding will be raised through fundraising activities. GVP's array was constructed adjacent to Highway I-70, a major expressway transecting Colorado from east to west. GRID and GVP worked with local companies to offer advertising space for signs installed on GVP owned land, adjacent to the array, that would be seen by motorists on Highway I-70. GVP paid for the signage, and the money used from advertising will help pay for GRID's expenses. GRID and GVP continue to look for additional advertising partners.

There was no financial transaction between GVP and Xcel; GVP's contract with Xcel allows for qualifying special projects to be constructed and not counted against the all-requirements power purchase agreements (PPA). GVP provided all bill credits to subscribers and does not get reimbursed from Xcel.

GVP retained its RECs, to help meet its 10 percent renewable energy goal by 2020. It should be noted that, as of 2017, GVP has exceeded this goal with a portfolio of 30 percent renewable energy.

PROJECT PRODUCTION

The estimated annual kilowatt hour (kWh) production of the solar garden was modeled using the National Renewable Energy Laboratory's System Advisor Model (SAM), and the system's long-term degradation was assumed to equal 0.7 percent per year. In Year 1, the system is expected to produce 56,336 kWh. Actual production data from May 2017 through September 2017 shows that the system produced 35,193 kWh, while estimated production during that same period was 28,352 kWh. During this timeframe, the system

produced 24 percent more electricity than expected.

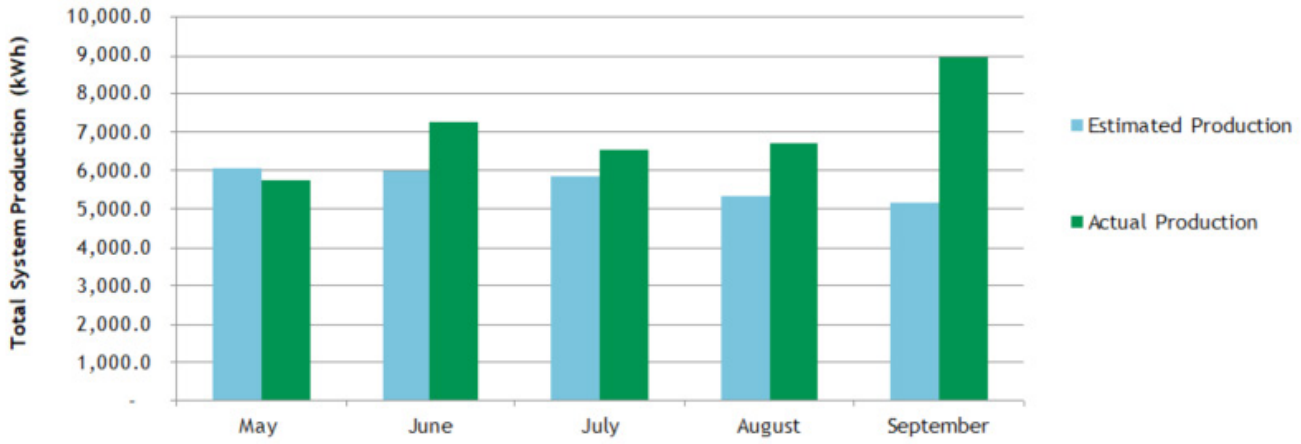
PROJECT OUTREACH

The success of GVP's previous community solar array phases helped build interest for new subscribers of Phase 5. Word of mouth within the community spread quickly, and many of GVP's members sought out subscriptions.

"A subscriber of Phases 2 through 4 was moving into a new home. She specifically looked for a home that was served by GVP so that she could re-enroll in the community solar project."
-Derek Elder, GVP Member Service Manager

Since HRWC provided a NeighborWorks grant to support the project, they claimed priority enrollment for their clients. HRWC will refer all of their eligible clients to GVP and GRID for subscriptions.

FIGURE 1: ESTIMATED VERSUS ACTUAL SYSTEM PRODUCTION



GRID sent out mailers to households that had been previously weatherized, and they reached out to subscribers that were on the waitlist from previous phases.

GVP did note some outreach challenges with the initial phases. For example, subscribers were concerned that there could be a "catch" and that it was "too good to be true". As was done with previous phases, GVP worked to overcome initial skepticism by presenting a transparent outreach platform.

SUBSCRIBER STATISTICS

The 36.54 kW solar garden will serve up to 10 subscribers, with each utilizing varying amounts of solar energy from the garden. (GVP's Phases 2 through 5 will serve up to 40 subscribers.) System sizes range from 1.2 kW to 4.8 kW, with an average system size of 3.2 kW. Subscribers have a four-year contract with GVP, and subscription contracts can be renewed. Systems are sized to offset approximately 50 percent of subscribers' electricity costs and 90 percent of subscriber's electricity consumption, based on the subscribers' previous 12-month electricity consumption.

COST STRUCTURE

The subscriber pays GVP the retail rate for electricity consumed plus fixed monthly charges. In return, GVP provides a bill credit to subscribers for the electricity produced by their panels.

The 2017 residential retail rate is $0.102 per kwh. Fixed charges include a grid connectivity charge that is equal to $30.

The bill credit is equal to $0.102 per kwh and will increase or decrease as GVP's residential rates fluctuate based on fuel costs. GVP also established a solar payment of $0.02 per kWh. This amount will remain fixed for the term of the contract. For subscribers, a constant and known solar payment provides insulation against rising electricity costs and helps subscribers budget for long-term energy costs.

"We can allocate the bill credits and continue doing so for 20 years so that we ensure that someone 'deserving' will benefit."

- Derek Elder, GVP Member Service Manager

On average, GVP's project is expected to save each subscriber approximately $590 each year. Assuming average annual electric utility costs of $1,200, based on GVP's historic data, the community solar garden, when combined with potential cost reductions of $200 achieved through CEO's weatherization assistance program, could reduce low-income subscribers' annual energy costs by approximately 66 percent.

GVP'S NEXT STEPS

When GVP first built Phase 1, GVP did not know that within a few year's time they would have constructed their final array, Phase 5. The community solar site is now at capacity and; therefore, GVP has no plans to build additional community solar arrays. GVP continues to advocate for low-income community solar and recently met with policy makers at Washington D.C. to propose community solar funding support through the national Community Development Block Grants.

Subscriber Spotlight: Gloria Martinez

Gloria Martinez is a single parent and has always looked for opportunities to save on household expenses. Approximately one year ago, she received a letter in the mail from HRWC about GVP's upcoming income-qualified community solar array.

Her neighbor was already a subscriber in one of GVP's community solar arrays and had seen monthly electric savings of between $30 and $40. She liked the program, and Gloria was encouraged to join. At the time, Gloria was told that they did not have space for her household to join and she was put on a waitlist of approximately eight to 12 months through HRWC's application process.

"I was looking forward to it [joining the community solar array]. And I waited anxiously for the discount in my electric costs."
-Gloria Martinez, Subscriber

Gloria is one of Phase 5's first subscribers. Her home was built through HRWC's Self-Help Build program, in which Gloria traded sweat equity for her home's down payment. Her home was built in accordance with good weatherization practices and will continue to benefit from reduced electricity costs associated with community solar. Even though GVP did not need additional volunteer support, based on her experience with HRWC's Self-Help Build program, Gloria would have gladly volunteered.

Estimated Versus Actual Performance

Due to the timing of this case study's release with GVP's subscription, it is unlikely that Gloria's household will have more than one month of solar production data to compare against estimated production. For a comparison of estimated to actual solar production data, please refer to the other Demonstration Project case studies.

Lessons Learned

SUCCESSES

- When it was built in 2015, Phases 2 through 4 was the first community solar garden completely dedicated to low-income households in the country.
- Phase 5 builds on four successful preceding community solar phases.
- The project has low operating costs and minimal O&M.
- The project aligned with GVP's core values and focused on services for low-income households.
- Board members, utility staff, and college students worked together to construct the array.
- GRID and GVP utilized innovative fundraising mechanisms.
- The project was the first of its kind to combine local weatherization service providers with low-income community solar.
- Subscriber electricity costs were reduced.
- When coupled with CEO's weatherization assistance program savings, this project has the potential to reduce energy costs by approximately 65 percent.

CHALLENGES

- The project had to use three different transformers, increasing the risk that an inverter could get shut off.
- GVP cannot build additional community solar arrays on the current site since it is at capacity.

PROGRAM CONSIDERATIONS

GVP's case study provides insight on how to optimize future low-income community solar garden projects.

Install the array on utility-owned land. Installing the array on land owned by the utility and adjacent to utility headquarters can simplify interconnection and help to save costs. Land that allows for a three-phase system will add system flexibility and may result in fewer losses at higher voltage.

Focus on the benefits to an underserved market when introducing the project to the utility's Board of Directors. Most income-qualified homes pay into utility rebate programs, but frequently cannot take advantage of those programs. As a result, they are left out and, often, do not benefit from general utility energy efficiency and renewable energy programs as other members. A low-income community solar project is a great way to reach out to these members and provide a service that will meet their needs.

Consider a phased approach. GVP's entire community solar array included five phases built over six years. GVP, its Board, and the community were able to learn from earlier phases. With a proven track record, community solar's subsequent phases were an easy sell to both GVP's Board and to the public.

Combine weatherization enrollment with income-qualified community solar. By integrating weatherization services with the income-qualified community solar project, GVP received additional support from their local weatherization program administrator, HRWC. HRWC provided funding support and helped with outreach and marketing. This reduced some of the programmatic burden for GVP and helped streamline the enrollment process.

Construct the array next to a major thoroughfare or other well visited site. GVP's array was constructed alongside one of Colorado's most heavily traveled highways. This provided a great opportunity to take advantage of raising additional funds through advertising. The location also increased public awareness and reinforced the project as a local renewable energy source.

POLICY CONSIDERATIONS

Lessons learned from the GVP community solar garden present the following policy considerations:

The solar payment structure affects subscriber's total cost savings. The amount that each subscriber pays to participate in community solar and associated escalation rates affect the subscriber's total savings. GVP solar payments will remain constant, following fluctuations in GVP's retail residential rate. Therefore, solar credits will grow over time and the subscriber's savings will stay relatively the same or slightly increase.

Project Snapshot

QUICK STATISTICS

- 36.5 kW solar garden
- Maximum 10 subscribers
- Early phases of this project were the first LMI community solar garden project in the nation

UTILITY TYPE

- Electric co-operative
- Serves 18,000 meters in Mesa, Delta and Garfield counties
- Receives wholesale electricity from Xcel Energy (Public Service Company of Colorado)

ENERGY BURDEN

- Approximately 14% of Mesa County, 16% of Delta County, and 10% of Garfield County residents live below the poverty line, compared to a statewide average of 12%.
- For those living at 50% of the poverty line, Mesa County residents have an energy burden of 21%, Delta County residents have an energy burden of 23%, and Garfield County residents have an energy burden of 22%.

PROJECT GOALS

1. Reduce members' energy costs by approximately 50%
2. Provide a utility program for low-income members
3. Provide locked-in energy prices

PROJECT PERFORMANCE

- Project target is approximately 50% cost savings
- Expected to produce 56,336 kWh annually
- Within five months, the system has produced 24% more electricity than expected

PROJECT COSTS

- Total project cost $55,250
- CEO grant $21,250
- GVP contribution $34,000 plus in-kind support, of which $30,000 was provided by HRWC's NeighborWorks grant

SUBSCRIBER PAYMENT STRUCTURE

- Costs and credits for 2017:
  - Retail rate $0.101/kWh
  - Monthly fixed charges ~$30
  - Solar credit rate $0.101/kWh
  - Subscriber solar payment $0.02/kWh

Low-Income Community Solar Demonstration Project Case Study:

Holy Cross Energy

SEPTEMBER 2017

COLORADO
Energy Office

Project Details

Holy Cross Energy's Demonstration Project Highlights

- The project is part of Holy Cross Energy's larger renewable energy strategy, which aims to increase the amount of solar on its grid by 40 percent by 2025.
- Subscribers receive project benefits on two-year terms.
- Subscribers are capped at 5kW due to the small size of the system, which will allow for an average project cost savings of 46 percent.
- Holy Cross Energy will work with GRID Alternatives, CEO's weatherization assistance program and local partners to ensure that clients receive energy efficiency education. and services.

INTRODUCTION

Approximately 30 percent of Colorado households pay more than 4 percent of their annual income on energy bills. Although several financial assistance programs exist to relieve high energy burden for low-income households, additional opportunities remain to achieve deeper cost savings by specifically targeting reductions in electricity costs.

The Colorado Energy Office's (CEO) Weatherization Assistance Program (WAP) is committed to improving energy affordability for low-income households. Guided by this commitment and in response to a gap in electricity cost reduction programs, CEO launched the Low-Income Community Solar Demonstration Initiative in 2015. The Holy Cross Energy demonstration project is part of the statewide initiative that aims to reduce electricity costs for low-income households by offering community solar options to households that are eligible for weatherization services.

OBJECTIVE

The demonstration project has eight utility partners, including Holy Cross Energy (HCE), a co-operative utility that provides electric services to more than 55,000 customers located in the counties of Eagle, Garfield, Gunnison, Mesa and Pitkin. This case study describes HCE's income-qualified community solar project and informs utilities, governments, and policy makers how community solar projects can impact low-income communities.

PROJECT PARTNER ROLES

HCE partnered with CEO and GRID Alternatives (GRID) to develop a 145 (kilowatt) kW community solar array that will support up to 45 low-income co-operative members at a time. The primary goal of the project was to reduce costs for low-income households and increase the amount of renewable energy on HCE's grid.

Each partner played a key role and will continue to play a key role moving forward:

- CEO provided project evaluation and funding support.
- GRID provided the design and implementation framework; designed and led the installation of a new 145 kW system; provided everything "behind-the-meter" including all equipment panels, inverters, balance of systems, and labor; developed workforce` training program; and provided communication and outreach support. Moving forward GRID will maintain equipment warranties.
- HCE provided funding support; the land and interconnection; conducted outreach; and managed subscriptions. Moving forward HCE will provide program administration, maintain full ownership, and conduct all operation and maintenance (O&M) activities.

PROJECT IMPLEMENTATION

The HCE Board has publicly supported and aggressively pursued renewable energy for more than a decade. In 2004, HCE committed to 20 percent renewable energy by 2020

(which they met in 2015) and, in 2016, HCE committed to 35 percent renewable energy by 2025, which they are close to achieving. In 2016, 34 percent of the electricity came from clean or renewable energy sources. Of that 34 percent, wind accounted for 13 percent, followed by solar (9 percent), biogas and biomass (7 percent), hydro (3 percent), and coal mine methane (2 percent). "Our ratepayers are large advocates of renewable energy, especially energy that is produced locally" said Chris Hildred, Power Supply and Special Projects Supervisor at HCE. In 2010, HCE partnered with community solar developer Clean Energy Collective (CEC) to provide the first third-party-owned community solar project in Colorado that provides renewable energy produced locally.

In 2015, GRID proposed working with HCE on the Demonstration Project. The project was introduced to HCE's Board of Directors in October 2015 and was approved for its ability to meet HCE goals of helping low-income members and increasing the amount of renewable energy on the grid. The solar garden was interconnected with HCE's grid in December 2016. The first subscriber was approved in December 2016 and the array was almost completely subscribed within three months. Subscribers began seeing cost savings in March 2017.

"This project is a win-win. It helps Holy Cross members who are having a hard time making ends meet and adds more renewable energy to our power supply mix."
– HCE former CEO Del Worley

The project was implemented using a turn-key installation in a "barn-raising" community development model, where subscribers donated 16 hours of sweat equity and worked alongside GRID, HCE staff, local elected officials, schools, and other community members to install 546 solar panels. The panels were installed on HCE property adjacent to a large

ENERGY GENERATION

HCE could directly connect their existing community solar garden to the grid, saving costs and time. Under most circumstances, HCE would have gone through the local jurisdiction to get electrical permits, but the Town of Gypsum waived the electrical permit since the array was connected directly to a utility resource on utility property.

Additionally, due to the array's small size, it is recognized as a qualifying facility under Public Utility Regulatory Policies Act (PURPA). A qualifying facility can either be a small power production facility (under 80 MW) or a cogeneration facility. This means that HCE did not have to get Xcel Energy's permission to install an array, which would have required more time and costs.

PROJECT COSTS

The project cost $400,099, with $174,000 covered by CEO's grant and $226,099 cash and internal time contributed by HCE for equipment ($194,300) and a line extension plus HCE staff time ($31,799). Direct project costs including equipment, construction materials and GRID staff time accounted for approximately 96 percent of total project costs, while outreach and administration accounted for approximately 1 percent and 3 percent of project costs, respectively. HCE also provided in-kind support including the donation of land, billing software, and ongoing program administration.

HCE believes that GRID's project was on par with other similar sized project costs. CEO's financial support was critical to the implementation of the project. However, even with CEO's support, HCE paid $226,099 that HCE does not expect to recoup.

"Without the CEO grant, the project would not have moved forward."
-Chris Hildred, Power Supply and Special Projects Supervisor

Moving forward, the project will include administration and recruitment costs. HCE is unsure how much it will cost to recruit new subscribers; however, it has built approximately $2,627 into the budget for admin and O&M costs each year with an annual increase of 3 percent.

PROJECT PRODUCTION

HCE plans to provide the benefit of community solar for 20 years. During that time, it expects the array to produce 5.37 million kWh and reduce costs for subscribers by more than $500,000.

The estimated annual kilowatt-hour (kWh) production of the solar garden was modeled using PVSyst. Long-term degradation is assumed to equal 0.5 percent per year. In Year 1, the system is expected to produce 228,147 kWh. Actual production data from mid-December through May show that the system produced 86,830 kWh, while estimated production during that same period was 106,231 kWh. During this timeframe, the system has produced 17 percent less electricity than expected. This is partially due to a conductor fault in one of the project's service panels on May

15 which knocked the array offline for more than a month. In addition, the array produced less electricity then expected in January and February due to abnormally high amounts of snow and clouds.

Solar produces energy while the sun shines and provides the most energy during peak solar radiation (which occurs at solar noon when the sun is highest in the sky). The low angle of the sun at sunrise and sunset results in the atmosphere filtering the sunlight more and results in less energy. Solar does not act as a peaking resource for HCE. In the winter, demand peaks from 7 p.m. to 10 p.m. when snowmaking is occurring at ski resorts and restaurants are open. In the summer, demand peaks between 5 p.m. and 7 p.m., which has minimal overlap with solar resources.

PROJECT OUTREACH

HCE and GRID used a variety of marketing platforms including program brochures, radio ads, promotion on HCE's website, and direct outreach to members. Due to its diverse membership, HCE and GRID also hosted five informational workshops in five separate communities (Aspen, Avon, Carbondale, Gypsum, and Parachute). Attendees were asked to bring their 2015 Federal Income Tax Return or other proof of income and a recent HCE energy bill. At the end of the workshop, attendees could sign up.

"While only a few people showed up to each workshop, they were worthwhile since we were able to help subscribers with their paperwork – which proved to be one of the hardest parts of attaining participants."
-Chris Hildred, Power Supply and Special Projects Supervisor

To qualify, subscribers had to be in good standing with HCE and have a total household income at or below the 80 percent Area Median Income (AMI) levels for their corresponding county (Eagle, Garfield, Gunnison, Mesa, or Pitkin).

SUBSCRIBER STATISTICS

The solar garden will serve up to 45 subscribers at a time, with each utilizing varying amounts of solar energy from the garden. In 2017, system sizes range from 0.53 kW to a maximum of 5 kW, with an average system size of 3.33 kW. Subscribers will receive benefits for a two-year period and can reapply for participation in the future.

Twenty-two of the 43 accounts had been previously served by CEO's Weatherization Assistance Program. The remaining 21 were eligible for weatherization or Energy Outreach Colorado program called Colorado's Affordable Residential Energy.

HCE's goal was to offset approximately 75 percent of each household's electricity use, based on the subscribers' previous 12-month electricity consumption, resulting in approximately 50 percent cost savings. However, many subscribers used electric heat that drastically increases electric demand. For example, the range of annual electricity used by subscribers ranged from 988 kWh to 39,823 kWh per year. To offset 75 percent of an electric-heated household demand, HCE would have had to allocate a much larger amount than the 5kW maximum.

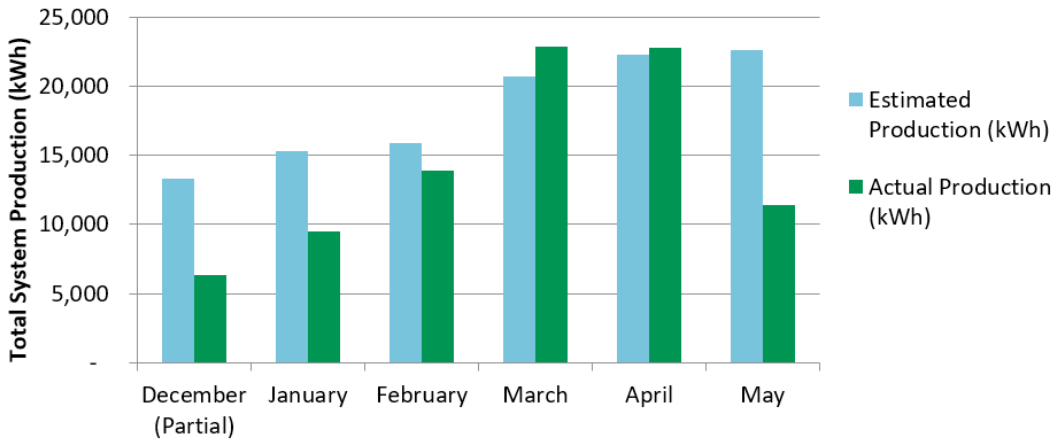
Sixteen of the 43 accounts receiving credits were at the 5kW program cap and will have less than 50 percent of their electricity cost offset. Due to the broad range of electricity use, the expected savings range for subscribers ranges from 15 percent to 57 percent.

COST STRUCTURE

The subscriber pays HCE the retail rate for electricity consumed plus fixed monthly charges. In return, HCE provides a bill credit to subscribers for the electricity produced by their panels.

The 2017 base residential retail rate is $0.0985 per kWh and is expected to continue to increase. The bill credit is the difference between the retail rate and the amount HCE

FIGURE 1: ESTIMATED VERSUS ACTUAL SYSTEM PRODUCTION



is charging for solar electricity ($0.02 per kWh). In 2017, the bill credit is $0.0785. Subscribers will pay HCE $0.02 per kWh for solar electricity consumed plus fixed monthly charges of $9. The solar payment will remain fixed for the term of the contract. Fixed charges include a monthly base charge, taxes, and a franchise fee. Taxes, franchise fees, and the WE CARE surcharge are all calculated as a percentage of base bill charges (consumption, service charge, etc.) and, therefore, they are largely tied to volumetric billing units.

This model provides subscribers insulation against rising electricity costs and helps subscribers budget for long-term energy costs. In addition, subscribers can carry credits forward on a monthly basis through the end of the subscription period.

Since HCE solar payments do not escalate, even though electricity retail rate costs do, the savings will grow over time as solar payments stay constant and the retail rate increases. For example, HCE subscribers in 2017 will save $0.0785 per kWh (they pay $0.02, compared to retail rate of $0.0985), while subscribers in 2041 could save approximately $0.121 per kWh, if retail rates escalate approximately 1.5 percent per year.

Using 2016 usage numbers, HCE's project is expected to save a total of $18,500 for all subscribers. Assuming an average annual electric cost of $49,000, subscribers will save on average of 40 percent. In addition, HCE has committed to encourage non-weatherized households participating in the program to reduce electricity use through CEO's Weatherization Program and the Energy Outreach Colorado program, Colorado's Affordable Residential Energy. With these factors, the impact could be much greater than 40 percent.

HCE'S NEXT STEPS

The community solar project is part of HCE's larger renewable energy strategy. In 2017, HCE issued a request-for-proposal for up to 5 MW's of photovoltaic electric generation located within HCE's certificated service territory and interconnected with its generation system. If the project moves forward, the amount of solar on HCE's grid will increase by 40 percent, and the amount of renewable energy will increase by 3 percent. This project is part of a larger plan to increase the amount of renewable energy and clean fuels on the grid, while reducing HCE's carbon footprint. HCE will also continue to encourage and deploy energy efficiency technologies throughout their territory.

Subscriber Spotlight: John and Amalia Castilla

John and Amalia Castilla are extremely busy parents of five growing children and are always looking for ways to reduce costs. Although they live in an energy efficient, Habitat-for-Humanity LEED-certified silver house, they are always proactively looking at ways to reduce their energy costs through energy conservation measures and behavioral change. Multiple times John and Amalia considered putting solar on their house to save money; however, they found solar to be too expensive. When John heard of the HCE Community Solar Garden project, he quickly jumped at the opportunity.

John attended the HCE information workshops, reviewed the handouts, and signed up immediately. Even though their home is energy-efficient, John believed his family could see significant electricity savings of almost 50 percent a year by participating. While the sign-up process was smooth, there was a large gap between signing up in November and receiving credits in March.

"Once the credits started to arrive on our bill, there was great educational material provided that explained how the program worked, why credits might fluctuate due to weather and time of year."

-John Castilla, Subscriber

The educational materials were especially helpful in explaining how important it is for the Castillas' house to be as energy-efficient over the summer when the solar array is producing the most electricity. As a reward for being energy efficient, the excess solar credits are rolled over month-to-month and can be used in the winter when the array is not producing as much electricity.

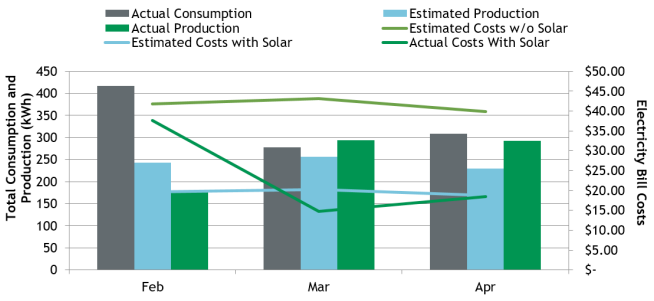
Estimated Versus Actual Performance

In 2016, the Castillas' household used 3,806 kWh and spent $487 on electric bills. To offset usage, the Castillas' household was allocated 1.9 kW of solar energy. The Castillas expected the solar to offset approximately 75 percent of their electricity usage and about 47 percent of their costs.

HCE SUBSCRIBERS: THE CASTILLA FAMILY

However, in the first full month of benefits they saw 100 percent of their electricity usage offset and their electricity costs offset by 61 percent. The remaining 39 percent of costs on their bill was from the fixed monthly costs and a WE CARE surcharge – a non-voluntary program run by HCE to reduce carbon emissions.

FIGURE 2: ESTIMATED VERSUS ACTUAL SYSTEM PRODUCTION FOR THE CASTILLAS



Utility data show that the Castillas' consumption to date was slightly higher (around 3 percent) than it was during the same time last year, and their solar allocation produced 11 percent less electricity than expected to date. The system may have produced less electricity than expected due to secondary fault in one of the panels which knocked the array offline and lower solar radiation then expected in December, January, and February.

Even if the solar array produces more electricity, subscriber costs will never be fully offset. Subscribers are required to pay a monthly fixed charge and if a subscriber lives in an incorporated area, they are required to pay a franchise fee of 3 percent. For example, the Castillas' average annual consumption is 3,806 kWh and they spend on average $487. If their system were to produce 100 percent of their usage, the Castillas will be required to pay an annual solar payment of $76.12 (3,806 kWh at $0.02 per kWh), 12 monthly charges for WE CARE program of $9.64 (12 months at approximately $0.80) and 12 monthly charges of $108 (12 months at $9 each month) for a total annual payment of $194. In this example, the most that the Castillas could save would be 60 percent.

Next Steps

The Castillas used their first month's savings to replace their CFLs with LEDs through the HCE rebate program. They hope to use additional savings to purchase the next energy-efficient upgrade – window shades -that keep out the cold during the winter and keep the home cool during the summer.

"The Community Solar project is a worry-free, win-win situation for us. The program is a great alternative to rooftop solar. We will see significant cost savings and reduce our environmental impact which is a wonderful blessing all around."

– John Castilla, Subscriber

Lessons Learned

SUCCESSES

- The project has low operating costs and minimal O&M.
- The project aligned with HCE's core values of reducing costs for low-income members and increasing the amount of renewable energy on the grid.
- Subscriber electricity costs were reduced.
- Lower electricity costs will help reduce the number of non-payments that HCE will receive.

CHALLENGES

- The project had a high capital cost.
- The avoided wholesale costs were lower than HCE would have liked since solar only meets Xcel Energy's peak demand about an hour a day during the summer.
- Without the CEO grant, the project would have been too expensive for HCE to pursue.
- The qualification process took multiple months.

PROGRAM CONSIDERATIONS

HCE's case study provides insight on how to optimize future low-income community solar garden projects.

Install the array on utility-owned land. Installing the array on land owned by the utility and adjacent to utility headquarters can simplify interconnection and reduce costs.

Partner with established community organization that work with low-income community. HCE stated the importance of working with community organizations that were trusted by low-income communities. Working through these organization allowed for easier, targeted marketing. The trust that these organization had already established resulted in subscribers being less hesitant to sign up for such an innovative program.

Be flexible with AMI requirements. Several utilities in the program used an AMI requirement of 200 percent or below. In HCE territory, this would significantly reduce the pool or potential candidates that could really benefit from the program. They believe an AMI requirement of 80 percent or below is more reasonable.

Set a realistic expectation of savings. HCE believes that you must provide a realistic expectation of cost-savings from the program upfront. They would recommend having a calculator out during the qualification process to make sure each household has an accurate estimate of savings.

Ensure consistent communication and expectations throughout the construction period. There were several constructions delays due to miscommunication and potentially mismatched expectations upfront.

Test out billing software in advance. HCE noted the importance of testing the system before sending out the first round of bill credits.

Make the connection between energy efficiency and savings. Subscribers will receive marketing materials for energy efficiency programs. HCE hopes that subscribers will take advantage of these programs to ensure that they still experience utility cost savings, once they are termed out after two years from the community solar program.

Put a cap on the amount of solar each participant can subscribe to. Due to the small size of the array, HCE thought it was important to put a cap on how much solar each participant could be allocated. For example, to offset 75 percent of one participant's electricity demand, HCE would have had to allocate 24 kW (about 17 percent of the total array) instead of the capped 5 kW to that household. By keeping the distribution small, more households can benefit.

POLICY CONSIDERATIONS

Lessons learned from the HCE community solar garden present the following policy considerations.

Wholesale costs can be the largest financial hurdle on whether a project is cost-effective for a utility. Where and how a co-operative utility purchases its power can greatly affect its ability to provide community solar. For example, HCE currently purchases a large share of their electricity from Xcel Energy but are not able to sell any additional power they create to other utilities. In the future, HCE hopes to participate in a market where they could sell surplus solar power to other utilities during the summer when HCE electricity demand is lower but electricity demand is higher for other utilities which experience higher air-conditioning needs. In addition, HCE could buy other renewable energy such as wind, hydro, and biomass to help offset their peak demand during the winter snow-making and tourism season.

Fixed charges play a significant role in the potential for reducing energy costs. Community solar incentives are typically provided as bill credits – credits on utility bills – and are issued as a dollar per kWh amount at a value less than retail rates. Fixed charges are not affected. While a subscriber's bill will be reduced by the bill credit amount,

the subscriber will always be responsible for paying fixed charges. The degree to which a subscriber's energy costs are reduced is a direct function of the amount of fixed charges relative to the cost of electricity. In the HCE solar model, subscribers have a very low monthly fixed cost of $9. This can lead to a very high reduction in costs, for example one subscriber experienced a 77 percent reduction in utility costs in one month. If the fixed costs do not completely cover the costs to serve a customer and the community solar program offsets all electricity costs, then the additional costs that are not covered to serve that subscriber will potentially be covered by non-participating members. On the flip side, low monthly fixed costs may disincentive utility from moving forward with a similar program due to a lower return-on-investment of a project.

The solar payment structure affects subscriber's total cost savings. The amount that each subscriber pays to participate in community solar and associated escalation rates affect the subscriber's total savings. HCE solar payments do not escalate even though electricity retail rate costs do. Therefore, the savings will grow over time as the solar payments stay constant and the retail rate increases. For example, HCE subscribers in 2017 will save $0.078 per kWh, while subscribers in 2041 could save approximately $0.121 per kWh.

Capping the size of a subscriber's portion of the project will affect high-electricity user's potential savings. HCE capped every subscriber at the less of 75 percent of their previous 12-month electricity use or 5kW. One subscriber's consumption would require a 24-kW system allocation using that sizing guidance. In return, the subscriber received only a 5 percent reduction in costs during the first month. Sixteen of the forty-three accounts that received credits were capped at the 5kW program cap.

Project Snapshot

QUICK STATISTICS

- 144.69 kW solar garden
- 43 subscribers
- 99.9% subscribed
- About half of subscribers have received Weatherization services

UTILITY TYPE

- Co-operative Utility
- Serves 56,000 meters located in the counties of Eagle, Garfield, Gunnison, Mesa, and Pitkin
- Receives wholesale electricity from Xcel Energy

ENERGY BURDEN

- Approximately 8% of residents in Eagle County, 10% in Garfield County, 13% in Gunnison County, 14% in Mesa County, and 7% in Pitkin County live below the poverty line, compared to a statewide average of 12%.

PROJECT GOALS

1. Reduce members' energy costs, specifically low-income households
2. Provide a local, resilient electricity source
3. Provide locked-in, predictable energy prices
4. Provide renewable energy and diversify energy supply
5. Enable HCE's staff to get hands-on experience
6. Support HCE's mission and ratepayer's values of renewable energy and energy justice

PROJECT PERFORMANCE

- On average, project expects approximately 46% cost savings and 53% electricity offset by solar
- Expected to produce 228,147 kWh annually
- To date, the system has produced 18% less electricity than expected

PROJECT COSTS

- Total project cost $400,099
- CEO grant $174,000
- HCE contribution $226,099, plus in-kind support

SUBSCRIBER PAYMENT STRUCTURE

- Costs and credits for 2017:
  - Retail rate $0.0985/kWh
  - Monthly fixed charges $9
  - Subscriber solar payment $0.02/kWh

Low-Income Community Solar Demonstration Project Case Study: Poudre Valley Rural Electric Association

NOVEMBER 2017

COLORADO
Energy Office

Project Details

Poudre Valley Rural Electric Association's Demonstration Project Highlights

- The 1.95-megawatt system is the largest solar project completed as part of the Demonstration Project.
- The energy output will benefit not only low-income households, but also affordable housing providers, nonprofit organizations, and all interested PVREA members.
- The project utilizes the Investment Tax Credit and Modified Accelerated Cost Recovery System.
- The project is sited on approximately nine acres of land south of the Larimer County Landfill.
- The project is expected to save low-income subscribers around 30% of the electricity portion of their PVREA bill.

INTRODUCTION

Approximately 30 percent of Colorado households pay more than 4 percent of their annual income on energy bills. Although several financial assistance programs exist to relieve high energy burden for low-income households, additional opportunities remain to achieve deeper cost savings by specifically targeting reductions in electricity costs.

The Colorado Energy Office's (CEO) Weatherization Assistance Program (WAP) is committed to improving energy affordability for low-income households. Guided by this commitment and in response to a gap in electricity cost reduction programs, the CEO launched the Low-Income Community Solar Demonstration Project (Demonstration Project) in 2015. The Demonstration Project is a statewide initiative that aims to reduce electricity costs for low-income households by offering community solar options to households that are eligible for weatherization services.

OBJECTIVE

The Demonstration Project has eight utility partners, including the Poudre Valley Rural Electric Association (PVREA), an electric co-operative utility that provides services for over 40,000 residences and businesses. This case study describes the "PV for All Program," which will provide solar benefits to 140 low-income households in Larimer, Boulder, and Weld Counties in Northern Colorado.

PROJECT PARTNER ROLES

PVREA partnered with the CEO and GRID Alternatives (GRID) to develop the 1.95-megawatt (MW) Coyote Ridge Community Solar Array that will serve low-income households, non-profits, and interested PVREA members. The low-income allocation of the array is 700-kilowatts (kWs), the non-profit allocation is 500 kW, and the traditional community solar array open to all PVREA subscribers is 750kW. The low-income portion will serve at least 140 households.

Each partner played a key role and will continue to play a key role moving forward:

- CEO provided project evaluation and funding support.
- GRID provided the design and implementation framework; designed and lead the installation of a new 1.95 MW system; provided everything "behind-the-meter" including all equipment panels, inverters, balance of systems, and labor; developed workforce training program; initial client outreach and acquisition; and provided communication and outreach support. Moving forward GRID will provide operations and maintenance (O&M) support.
- PVREA provided financing for the project; the land acquisition and interconnection; conducted outreach; billing and software programming; and managed subscriptions. Moving forward PVREA will provide program administration, maintain project control, and lead O&M activities.

PROJECT IMPLEMENTATION

PVREA's mission is to serve its members with innovative energy solutions; the co-operative is committed to researching new technologies that maintain reliability, make economic sense for the membership, and conserve natural resources. PVREA purchases energy from Tri-State Generation and Transmission, which as of 2016 has approximately 27 percent of their electricity coming from renewable energy resources. In addition to the renewable energy provided by Tri-State, PVREA now has six solar farms with cumulative capacity of over 15.5 MW and a hydropower facility that produces enough electricity to power over 1,000 homes.

PVREA has also committed to making renewable energy accessible to all members. In early 2016, GRID proposed working with PVREA on the Demonstration Project. The project was introduced to PVREA's Board of Directors and was approved in February 2017 for its ability to meet PVREA's goals of helping low-income members and increasing the amount of renewable energy on the grid. The solar garden was interconnected with PVREA's grid in October 2017. The first subscriber was approved in October 2017 and subscribers are expected to start seeing cost savings as of November 2017.

"Poudre Valley Rural Electric Association is pleased to partner with GRID Alternatives and the Colorado Energy Office on a solar project to benefit cooperative members who have desired to participate in solar energy but have been unable. The Coyote Ridge Community Solar Farm exhibits the cooperative nature of our local electric co-op – it brings all of our members together by providing an opportunity to participate in the construction and energy output of the solar farm."
-PVREA President and CEO Jeff Wadsworth

The project was implemented using a turn-key installation in a "barn-raising" community development model, where over 300 subscribers and volunteers provided sweat equity and worked alongside GRID employees. The panels were installed on land leased from Larimer County that was used to support Landfill operations.

ENERGY GENERATION

PVREA's Coyote Ridge Community Solar Farm has a project life of 20 years and PVREA expects the array to produce around 65,000,000-kilowatt hours (kWh). The estimated annual kWh production of the solar garden was modeled using PVSyst with an expected degradation rate of 0.5-0.7 percent per year. The project uses a single-axis tracking system to increase production.

The project is located on approximately nine acres of land leased from Larimer County. As a partner in the project, the Larimer County Landfill removes soil from the site for landfill operations. Due to being over five acres of impacted area, the project was required to complete a 1041 permit application. The permit application requires extensive assessment of environmental and social impacts, but the Larimer County Landfill had already completed similar analysis for Landfill activities. Thus, the extensive permitting project was manageable for a project of this scale.

Under contractual requirements, all production from the project must be used on the local distribution system. In other words, no production can back feed onto the bulk electric transmission infrastructure. To ensure compliance with this requirement, PVREA sited the project in an area with adequate and growing electrical load. The project also utilizes recently upgraded distribution lines.

PVREA self-generation is limited to a maximum of 5 percent of total energy sales through an all requirements contract with Tri-State Generation and Transmission Association. However, even with the addition of the Coyote Ridge Community Solar Array, PVREA is still under the 5 percent maximum. As a result, this was not an issue for this project.

PROJECT COSTS

The low-income portion of the project cost $1,175,000, with $200,000 covered by CEO's grant. Direct project costs included operations (such as equipment, construction materials and GRID staff time), outreach, and administration. Operations accounted for approximately 96 percent of total project costs, while outreach and administration accounted for approximately 1 percent and 3 percent of project costs, respectively. PVREA provided in-kind support including billing software, ongoing program administration and land acquisition.

To cover the significant costs of the project, PVREA looked at various financing models including a tax equity flip,

tax advantage lease, leaseback, direct loans, and Clean Renewable Energy Bonds (CREBs) from the Department of Energy. However, after significant review PVREA decided to do a leaseback structure with CoBank, a co-operative bank which offered a 12-year term length. CoBank was the tax equity inventory and took advantage of all the tax benefits (Investment Tax Credit and Modified Accelerated Cost Recovery System) of the leaseback structure.

Since PVREA will have over 140 participants, there are higher overhead costs for recruitment and contracting then other Demonstration Projects.

"PVREA decided to do the leaseback structure due to relative simplicity and attractive rates available through a trusted cooperative partner."
– Milton Geiger, Alternative Energy Administrator at PVREA

Some of the project costs are being covered by the non-profit and traditional community solar subscribers. Traditional community subscribers were allocated 750 kW and are required to pay an initial fee of $48 per panel and an ongoing monthly subscription fee of $3.55 per month. Non-profits are allocated 500 kW and are required to pay an initial set up fee of $16 per panel and an ongoing monthly subscription fee of $3.55 per month. By including non-profits and middle and upper income households the project was cash flow positive.

PROJECT OUTREACH

The LMI portion of the project was branded as "PV for All." PVREA branded the entire community solar program that is available to all PVREA members "myLocal Solar." PVREA promoted the program on their website. GRID and PVREA led subscriber outreach through bill stuffers and informational workshops. Attendees to workshops were asked to bring their 2016 Federal Income Tax Return or other proof of income and a recent PVREA energy bill. At the end of the workshop, attendees that were still interested could sign up. In addition, PVREA promoted the program on their website and allowed participants to apply directly online.

SUBSCRIBER STATISTICS

The 700kW low-income solar garden portion will serve at least 140 subscribers, with each household receiving various shares of solar energy from the garden. PVREA's goal is to cover up to 100 percent of each household's electricity usage with a 5-kW limit and help each household save approximately 30 percent on the energy portion of their bill. Subscribers are limited to a four-year benefit with PVREA. Members can renew but will need to reapply.

COST STRUCTURE

The subscriber pays PVREA the retail rate for electricity consumed plus a fixed monthly facilities charge. By participating in the myLocal Solar or PV for All program, PVREA provides a bill credit to subscribers for their share of the electricity produced by the system.

The 2017 base residential retail rate is $0.09396 per kWh and is expected to continue to increase over time. The bill credit is the same as that provided to PVREA market rate community solar project, currently at $0.065772 per kWh. The solar payment will increase annually for the term of the contract at the same percentage as the standard residential rate. The solar payment was structured to achieve a 30 percent discount off normal energy rates.

This model provides subscribers insulation against rising electricity costs and helps subscribers budget for long-term energy costs. In addition, subscribers can carry credits forward month to month, with an annual true-up in March of each year.

PVVEA NEXT STEPS

PVREA will continually monitor the program to see if there are ways to improve the program. For example, in the future PVREA might require energy efficiency as part of the program or target weatherized homes. In addition, PVREA will continue to explore future cost-effective solar projects and other renewables.

Lessons Learned

SUCCESSES

- The project is cash flow positive, allowing for potential replicability.
- The project cost effectively increased production using single axis trackers.
- The project aligns with PVREA's core mission of providing efficient, energy solutions to their members.
- The project has the potential to reduce subscriber's electricity costs by over 30%.

CHALLENGES

- Finding a location for the system and working through extensive permitting requirements.
- Without the CEO grant, the project would have been less cost effective for PVREA.
- myLocal Solar and the PV for All portion of the project is one of PVREA's first consumer facing offering so there is a steep learning curve for PVREA.
- Some of the PV parts were delayed 2 months, delaying the installation.

PROGRAM CONSIDERATIONS

PVREA's case study provides insight on how to optimize future low-income community solar garden projects.

Consider multiple financing sources. PVREA researched multiple financing and funding sources before moving forward with a leaseback structure. Through this research, PVREA could find the most cost-effective structure that met their project goals and timeline.

Take advantage of economies-of-scale. PVREA was able to take advantage of economies-of-scale benefits, such as reduced per unit installation costs and access to tax incentives.

Consider splitting the project into low-income and full payment subscribers. By splitting the project into low-income households where the community solar was subsidized and subscribers that paid for the solar at a premium, PVREA's project was able to be cash flow positive. As such, this model could prove replicable.

Install array on land that is otherwise unused. Although installing the solar garden next to an active landfill site proved to be somewhat challenging, it did provide significant benefits. This not only helped build support throughout the community, but also provided access to land in an area where other large tracts would have been prohibitively expensive.

Set a realistic expectation of savings. PVREA believes that you must provide a realistic expectation of cost-savings from the program upfront to ensure the subscribers do not expect larger savings they receive.

Project Snapshot

QUICK STATISTICS

- 1.95 MW solar garden with 700 kW allocated to LMI subscribers
- At least 140 subscribers

UTILITY TYPE

- Co-operative
- Serves 40,000 homes and businesses members in Larimer, Boulder, and Weld Counties
- Receives wholesale electricity from Tri-State Generation and Transmissions

ENERGY BURDEN

- Approximately 12.2% of Larimer County, 12.3% of Boulder County, and 11.3% of Weld County residents live below the poverty line, compared to a statewide average of 12%.

PROJECT GOALS

1. Reduce members' electricity costs
2. Provide a local, resilient electricity source
3. Provide locked-in energy prices
4. Provide a renewable energy option for members.

PROJECT PERFORMANCE

- Project target is approximately 30% cost savings
- Expected to produce 1,250,000 kWh annually for LMI portion of project

PROJECT COSTS

- Total project cost $1,375,000
- CEO grant $200,000
- PVREA Financed $1,175,000

SUBSCRIBER PAYMENT STRUCTURE

- Costs and credits for 2017:
  - Average retail rate $0.09396/kWh
  - Monthly fixed charges ~$24.50
  - Solar rate $0.065772/kWh (30% reduction in energy cost)

Low-Income Community Solar Demonstration Project Case Study: San Miguel Power Association

OCTOBER 2017

COLORADO
Energy Office

Project Details

San Miguel Power Association's Demonstration Project Highlights

- SMPA integrated its low-income community solar garden with its income-qualified weatherization program.
- A portion of SMPA's low-income community solar garden was funded by SMPA's Green Fund -- a fund supported by Renewable Energy Credit (REC) purchases.
- SMPA's low-income community solar garden was constructed on an old landfill, transforming a brownfield to a "brightfield".
- On average, subscribers will realize annual cost savings of $134, and when combined with average cost savings of $200 from CEO's WAP, subscribers could see annual savings of $334.

INTRODUCTION

Approximately 30 percent of Colorado households pay more than 4 percent of their annual income on energy bills. Although several financial assistance programs exist to relieve high energy burden for low-income households, additional opportunities remain to achieve deeper cost savings by specifically targeting reductions in electricity costs.

The Colorado Energy Office's (CEO) Weatherization Assistance Program (WAP) is committed to improving energy affordability for low-income households. Guided by this commitment and in response to a gap in electricity cost reduction programs, the CEO launched the Low-Income Community Solar Demonstration Project (Demonstration Project) in 2015. The Demonstration Project is a statewide initiative that aims to reduce electricity costs for low-income households by offering community solar options to the same households that are eligible for weatherization services.

OBJECTIVE

The Demonstration Project has eight utility partners, including San Miguel Power Association (SMPA), a rural electric co-operative utility with 13,400 meters serving Ouray, San Juan, San Miguel, Montrose, Mesa, Hinsdale, and Dolores Counties. This case study describes SMPA's income-qualified community solar project and seeks to inform utilities, local governments, and policymakers on the ways in which community solar projects can impact low-income communities.

PROJECT PARTNER ROLES

SMPA partnered with the CEO and GRID Alternatives (GRID) to develop a 125 kilowatt (kW) community solar array for up to 60 low-income co-operative members. In the event that there is additional demand, SMPA built an additional 72 kW array. If there is not enough demand to subscribe additional income-qualified households, SMPA will open the array up to all members.

The Telluride Foundation and its affiliates -- Johnson Family Fund, McManemin Family Fund, Hermitage Fund, and Paradox Community Trust Fund -- also partnered with SMPA to provide funding assistance.

The primary goal of the low-income project was to provide an accessible renewable energy source for income-qualified members.

Each partner played a key role:

- CEO provided project evaluation and funding support.
- GRID provided the design and implementation framework, designed and lead the installation of a new 197 kW system, provided workforce integration, helped with permitting, provided outreach, and managed subscriptions. Moving forward, GRID will conduct primary operation and maintenance (O&M) activities and maintain equipment warranties.
- SMPA provided funding support, lead fundraising efforts, provided the land and interconnection, and conducted outreach. In addition, SMPA will provide bill credits and billing support, maintain full ownership, and support O&M.

PROJECT IMPLEMENTATION

The project was first introduced to SMPA's Board of Directors in late fall of 2015 and was not approved until the spring of 2016. It was approved because of its benefit to low-income members, its synergy with member values, including support for renewable energy, and the ability to repurpose a brownfield.

"Our position as a non-profit organization is essential to our perspective as a utility. We are tasked with serving all members of our community. The best ways to do this, and to bring electricity to the end user, is to develop programs that serve low-income households and support local economic development." – Wiley Freeman, SMPA Manager of Member Services

The area had a strong history of NIMBYism ("not-in-my-backyard" philosophy) and SMPA had difficulty getting approval for large-scale solar photovoltaic projects in the past. This time, SMPA approached its board and other community leaders from a different angle. They knew that many of the region's residents wanted more renewable energy in the Valley and they asked various community leaders where the community solar garden should be located. The community leaders responded positively to this approach and SMPA, along with the County staff and commissioners, chose to construct the community solar garden on a former landfill owned by San Miguel County about 45 minutes away from SMPA's headquarters in the small town of Norwood. This solution not only brought more renewable energy to the Valley, but made use of an otherwise unused parcel of land without obstructing existing mountain views.

Though the placement was ideal for the community, re-purposing an old landfill had numerous challenges including state permitting, water quality compliance, grading, and land management. The post-closure actions significantly delayed construction.

"Building on a retired landfill was the number one factor that influenced the timeline of our construction." – Wiley Freeman, SMPA Manager of Member Services

Fortunately, both the state and San Miguel County were big champions of the project and helped SMPA streamline the landfill closure procedures. SMPA leased the land from San Miguel County for a negligible annual fee, and the land was eventually transitioned from a brownfield to a "brightfield."

SMPA and their stakeholders found that capping a landfill with a community solar project actually improves the land. Solar systems require specific grading, which leads to less erosion and better vegetation coverage with native grasses and plants. Numerous prairie dog issues existed when the site was a landfill, but during the solar garden process, the team was able to improve the prairie dog habitat. The existing fence was in poor condition, and with construction of the solar garden, a newer and more robust fence was built.

"Since we will monitor the site for 20 years, we no longer have a neglected piece of land." – Wiley Freeman, SMPA Manager of Member Services

With the exception of the meter, the garden was completed in March 2017. The solar garden was interconnected with SMPA's grid in June 2017. The first subscriber signed up June 2017, and as of July 2017, the community solar garden was nearly 45 percent subscribed. Subscribers will begin to realize cost savings approximately one month after they are signed up.

To qualify, subscribers must earn less than 80 percent of HUD's area median income (AMI). SMPA may refer subscribers and deny subscriptions due to poor credit history, history of unpaid bills, and/or illegal activity. SMPA has committed to providing program subscriptions for 20 years, with individual subscriptions lasting five years. All subscribers were required to have either received home improvements through SMPA's income-qualified (IQ) Weatherization Program or through CEO's weatherization program.

The project was implemented using a turn-key installation in a "barn-raising" community development model, where volunteers donated sweat equity and worked alongside GRID and SMPA. Typically, GRID encourages utilities to enlist the help of subscribers. However, because SMPA found that many potential subscribers were elderly, on disability, or even connected to oxygen tanks, SMPA did not require volunteer time from subscribers and rather opened volunteer opportunities to the community at large.

Though the solar garden was installed nearly 40 miles away from SMPA's headquarters, the community solar production meter was interconnected directly to SMPA's electric grid. The array was inspected by the state electrical inspector, and was exempt from state electric board regulations.

SMPA and GRID were able to construct the solar garden using mostly local contractors who possessed complementary

skillsets. When equipment that may have been more accessible in urban areas was not available, many members of the local community pitched in and provided assistance to the project.

"Local folks helped out logistically. In one instance, we found a local farmer and were able to call upon him for trenching equipment. In another case, we employed a neighbor's relatives to help with concrete work. Part of the success of this project was due to the fortitude of the locals." – Kam Jaspal, GRID Alternatives Land and Project Development Manager

ENERGY GENERATION

SMPA entered a contractual relationship with SMPA's wholesale electricity provider, Tri-State Generation and Transmission Association, Inc. (Tri-State). Tri-State's Board of Directors' Renewable Energy Policy 115 governs the terms under which SMPA can "self-generate" and lists the bill credit rates paid by Tri-State to SMPA for the electricity generated by the community solar array. Tri-State will provide bill credits to SMPA for the life of the 20-year Policy 115 and then will bill SMPA for the electricity produced by the community solar array. SMPA's wholesale electric service contract also limits co-operative owned electricity generation system sizes to no more than 5 percent of the co-operative's total load.

Tri-State also offers Renewable Energy Policy 117 that governs the renewable energy credit (REC) transaction with member co-operatives. However, Policy 117 does not apply to SMPA's low-income community solar project since SMPA choose to retain ownership of the RECs. SMPA will sell the RECs at a premium to local organizations and invest the money into their Green Fund, which is an escrow account that is used to fund energy efficiency and renewable energy projects and programs. SMPA has used the Green Fund to pay for qualifying projects for the last nine years and continually replenishes the fund using money received from the sale of projects' RECs.

"Our community has a big appetite for RECs. We have used them to create a positive feedback loop over the last 9 years." – Wiley Freeman, SMPA Manager of Member Services

PROJECT COSTS

The low-income community solar project cost $456,000, with $135,000 covered by CEO's grant and $330,000 contributed by SMPA, of which the Telluride Foundation and its affiliates granted $50,000 and $30,000 was provided in-kind by SMPA. Direct project costs included operations (such as equipment, construction materials and GRID staff time), outreach, and administration. Operations accounted for approximately 96 percent of total project costs, while

outreach and administration accounted for approximately 1 percent and 3 percent of project costs, respectively. SMPA provided in-kind support including billing software, ongoing program administration, and leasing of the land.

Tri-State's Renewable Energy Policy 115 requires SMPA to pay Tri-State for electricity consumed by its members even though that consumption is offset by the community solar project. SMPA must also pay GRID an annual operation and maintenance fee. Even with the O&M fee, SMPA expects the project to be budget neutral every year of the contract term.

SMPA used money from its Green Fund to help pay for the low-income community solar project.

"We created a "solar endowment" to help improve the quality of life for those folks who need help paying for their utilities. We could have invested this money in the stock market, but we used it to create a solar project." – Wiley Freeman, SMPA Manager of Member Services

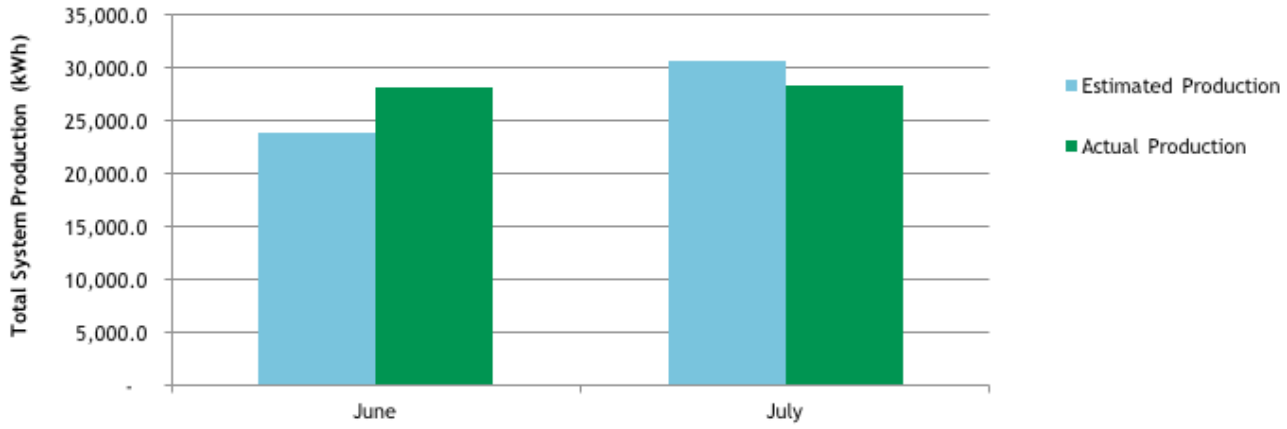
PROJECT PRODUCTION

The estimated annual kilowatt hour (kWh) production of the solar garden was modeled using the National Renewable Energy Laboratory's System Advisor Model, SAM, and the system's long-term degradation was assumed to equal 0.7 percent per year. In Year 1, the system is expected to produce 315,735 kWh. Actual production data from June 2017 through July 2017 shows that the system produced 56,484 kWh, while estimated production during that same period was 54,497 kWh. During this timeframe, the system produced 3.6 percent more electricity than expected.

PROJECT OUTREACH

SMPA developed a targeted marketing campaign, in which it called over 70 previously weatherized households who received services through SMPA's IQ Weatherization Program.

FIGURE 1: ESTIMATED VERSUS ACTUAL SYSTEM PRODUCTION



Based on previous marketing efforts, SMPA leveraged existing relationships and continued conversations with the clients they knew would be eligible and would benefit from additional energy assistance. GRID also assisted with outreach by sending out postcards and emails and conducting a call campaign.

Subscribers were excited to get signed up to both programs; yet, there was a significant delay in enrollment between the two programs. Initial marketing for the community solar garden began with the development of SMPA's IQ weatherization program in the summer of 2016 and community solar garden subscribers were not enrolled until early summer of 2017.

"Folks were very excited about the IQ weatherization program and community solar. They patiently waited to get signed up!" – Wiley Freeman, SMPA Manager of Member Services

Though SMPA never completed any in-person outreach, its targeted marketing via phone calls proved valuable. SMPA noted that the biggest outreach hurdle was ensuring that all potential subscribers completed the program application.

SUBSCRIBER STATISTICS

The 125 kW solar garden is designed to serve approximately 60 subscribers, with each utilizing varying amounts of solar energy from the garden. System sizes are limited to 2 kW. Subscribers have a five-year contract with SMPA, and subscription contracts can be renewed. Subscribers are expected to save approximately 50 percent of their usage based on a demand of 2 kW. Additional capacity of 72 kW is available to income-households as needed.

COST STRUCTURE

The subscriber pays SMPA the retail rate for electricity consumed plus fixed monthly charges. In return, SMPA provides a bill credit to subscribers for the electricity produced by their panels.

The 2017 residential retail rate is $0.135 per kWh. The fixed monthly access charge is approximately $18. The bill credit is currently equal to $0.0527 per kWh and will increase at varying amounts between 1 and 3 percent until 2027, at which point the credit will remain constant at $0.067 per kWh. SMPA set the solar credit equal to what they receive as a bill credit from Tri-State. The difference between the retail rate and the bill credit is the solar payment. In 2017, it is set at $0.082 per kWh and will vary as the retail rate and solar credit rate varies.

By setting the customer's solar credit equal to Tri-State's solar credit, SMPA provides a pass-through credit to its customers. This ensures that the project is budget neutral and helped sell the project to SMPA's member base.

On average, SMPA's project is expected to save each subscriber approximately $134 in the first year. Assuming average annual electric utility costs of $1,250 based on SMPA's historic data, the community solar garden, when combined with potential cost reductions of $200 achieved through CEO's WAP, could reduce low-income subscribers' annual energy costs by approximately 27 percent.

SMPA'S NEXT STEPS

In light of Tri-State's 5 percent self-generation cap, SMPA still sees room for renewable energy growth. SMPA is working with Tri-State and other member co-operatives to develop more community solar and provide as many energy efficiency and renewable energy options to its members as possible.

Subscriber Spotlight: Evelyn Nelson

Evelyn Nelson and her husband are two professionals with a large family trying to make ends meet. They signed up for SMPA's program July 2017 and expect to save 5 percent to 7 percent on their electricity costs each year.

"This is a good program for family that do not qualify for [other] help, but still need some assistance."
– Evelyn Nelson, Subscriber

Evelyn had a contractor perform an energy assessment on their house through SMPA's IQ Weatherization Program. The contractor left a card about SMPA's new IQ community solar program. At first, Evelyn was hesitant to sign up; she didn't understand how a community solar program could work for her and her family. She reached out to GRID and SMPA for more information. They were very helpful, and worked closely with her to answer questions and make sure that she felt comfortable about the process. Signing for the program was easy and her application was quickly approved.

Her family had always been interested in renewable energy and the fact that this project would result in cost savings was an obvious win.

"I am grateful to be part of a program that helps the environment, while helping community members."
– Evelyn Nelson, Subscriber

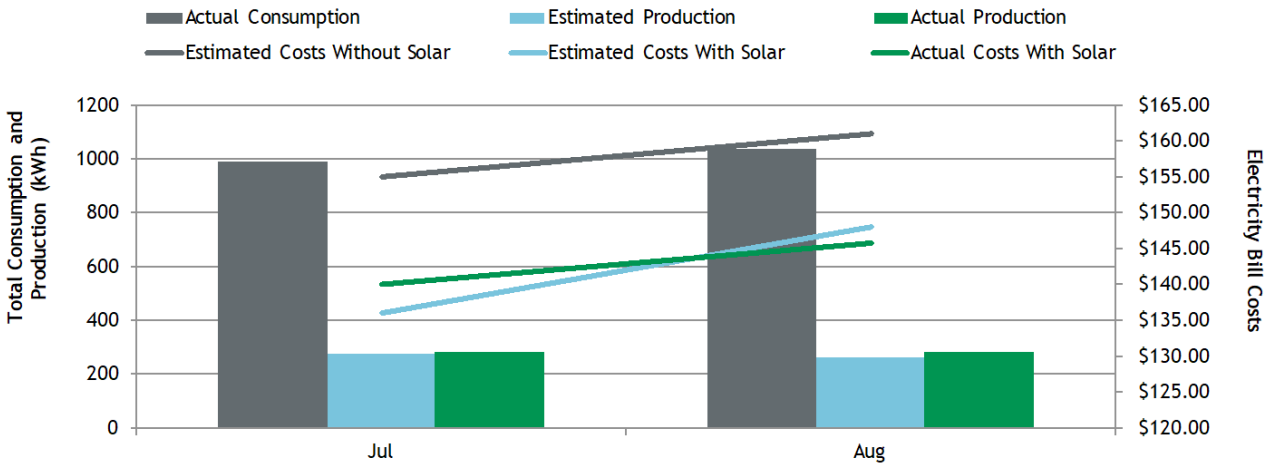
SMPA SUBSCRIBERS: THE NELSON FAMILY

Estimated Versus Actual Performance

In the past 12 months, the Nelson household used 15,536 kWh and spent $2,310 on electric bills. To offset usage, the Nelson's household was allocated 2.0 kW of solar energy. The solar system was expected to offset 20 percent of their usage and save 7 percent of their costs annually.

During the first two months of the array being online, the Nelson's solar system offset usage by 28 percent and saved 10 percent on their electricity costs. To date the system has produced 5 percent more electricity than estimated.

FIGURE 2: ESTIMATED VERSUS ACTUAL PRODUCTION FOR THE NELSON HOUSEHOLD



Lessons Learned

SUCCESSES

- SMPA used money from its revolving Green Fund to help pay for the initial community solar costs.
- The community solar garden transformed a brownfield to a "brighfield" by making use of an old landfill site.
- SMPA enlisted participation from its existing IQ weatherization program, increasing the savings potential for income-qualified households and streamlining outreach and marketing.
- The project has low operating costs and minimal O&M.
- The project aligned with SMPA's core values and member's values: serving income-qualified households and bringing more renewable energy to the Valley.
- Subscriber electricity costs were reduced.
- Lower electricity costs will help reduce the number of non-payments that SMPA will receive.
- A majority of the project construction was executed by local contractors.
- When coupled with WAP savings, this project has the potential to reduce energy costs by approximately 25 percent to 30 percent.

CHALLENGES

- The project had a high capital cost.
- As a Tri-State member, SMPA was required to pay wholesale electricity costs for electricity consumption that was offset by the community solar garden.
- Even with the CEO grant and GRID's support, it was difficult for SMPA to provide maximum benefit to subscribers while balancing utility costs.
- The site was remote and was difficult to quickly access.
- Local expertise in solar was limited.
- Closing the landfill and getting a special use permit was difficult and time-consuming, taking between eight to nine months to complete.

Lessons Learned

PROGRAM CONSIDERATIONS

SMPA's case study provides insight on how to optimize future low-income community solar garden projects.

Install array on land that is otherwise unused. Although installing the solar garden on an old landfill site proved to be somewhat challenging, it did provide significant benefits. This not only helped build support throughout the community, but also lowered project costs, avoided NIMBYism issues, and will actually improve the land over time.

Consider a pass-through bill credit structure. It is difficult for utilities to design solar projects that are budget neutral. If a utility is receiving a bill credit from their wholesale provider, considering passing along the exact same credit to the subscriber to avoid an annual deficient. It should be noted that though this approach provides a balanced financial return, it does limit the ability of the utility to increase cost savings to its members.

Consider pairing a low-moderate income community solar garden with other IQ energy efficiency programs. By improving efficiency first, a smaller renewable energy system is required to offset electric consumption. Plus, the same participants can be part of both programs, which simplifies outreach and marketing.

When NIMBYism issues are at play, work with the community to develop the community solar garden. Getting early buy-in on site placement, using local contractors, and touting the benefits of clean energy can help overcome legacy biases against renewable energy systems.

POLICY CONSIDERATIONS

Lessons learned from the SMPA community solar garden present the following policy considerations.

Wholesale power purchase agreements affect a co-operative utility's ability to offer community solar. Where and how a co-operative utility purchases its power can greatly affect its ability to provide community solar. SMPA was limited in its ability to offer more community solar and to manage operating costs because of Tri-State's Board of Directors' Renewable Energy Policy 115, which limit self-generation to 5 percent of total consumption and require that SMPA pay for the electricity consumed by its members that is offset by solar. In addition, Tri-State's renewable energy policies prohibit the community solar array from offsetting peak demand charges. If Tri-State had accepted peak demand offsets from SMPA, SMPA could have realized an additional few thousand dollars of savings each year.

The bill credit structure affects subscriber's total cost savings. The amount that each subscriber pays to participate in community solar and associated escalation rates affect the subscriber's total savings. SMPA's bill credits will not escalate after the year 2027 even though electricity costs will. Therefore, solar payments will grow over time and the subscriber's savings will stay relatively the same or slightly decrease.

Limiting the size of a household's system reaches more households but reduces an individual's potential for cost savings. SMPA limited each household's system size to 2 kW, even when consumption exceeds 2 kW. This allowed SMPA to make a broader impact on its member base, but reduced a household's potential savings to 5 percent to 10 percent of total costs (based on an estimate of 50 percent savings from a 2 kW system).

Project Snapshot

QUICK STATISTICS

- 125 kW to 197 kW solar garden
- Maximum 60 subscribers for the 125 kW array
- 45% subscribed
- Converted a brownfield to a "brightfield"
- Partially funded by SMPA's Green Fund
- Paired with SMPA's IQ Weatherization Program
- 100% of current subscribers have received or signed up to receive either CEO's weatherization services or SMPA's IQ weatherization services
- Uses Tri-State Board of Director's Renewable Energy Policy 115

UTILITY TYPE

- Rural electric co-operative
- Serves 13,400 meters in Ouray, San Juan, San Miguel, Montrose, Mesa, Hinsdale, and Dolores Counties
- Receives wholesale electricity from Tri-State Generation and Transmission, Inc.

ENERGY BURDEN

- Approximately 9% of Ouray County, 16% of San Juan County, 11 % of San Miguel County, 18% of Montrose County, 14% of Mesa County, 11% of Hinsdale County, and 15% of Dolores County residents live below the poverty line, compared to a statewide average of 12%
- For those living at 50% have an energy burden of 28%, San Juan County residents have an energy burden of 36%, San Miguel County residents have an energy burden of 26%, Montrose County residents have an energy burden of 23%, Mesa County residents have an energy burden of 21%, Hinsdale County residents have an energy burden of 36%, and Dolores County residents have an energy burden of 27%.

PROJECT GOALS

1. Serve income-qualified households
2. Provide renewable energy and diversify energy supply
3. Repurpose a brownfield

PROJECT PERFORMANCE

- Project target is approximately 50 percent usage savings based on a system size of 2 kW
- Expected to produce 315,735 kWh annually
- Within two months, the system has produced 3.6% more electricity than expected

PROJECT COSTS

- Total project cost $465,000
- CEO grant $135,000
- SMPA contribution $330,000, including $30,000 in kind and a $50,000 grant from the Telluride Foundation

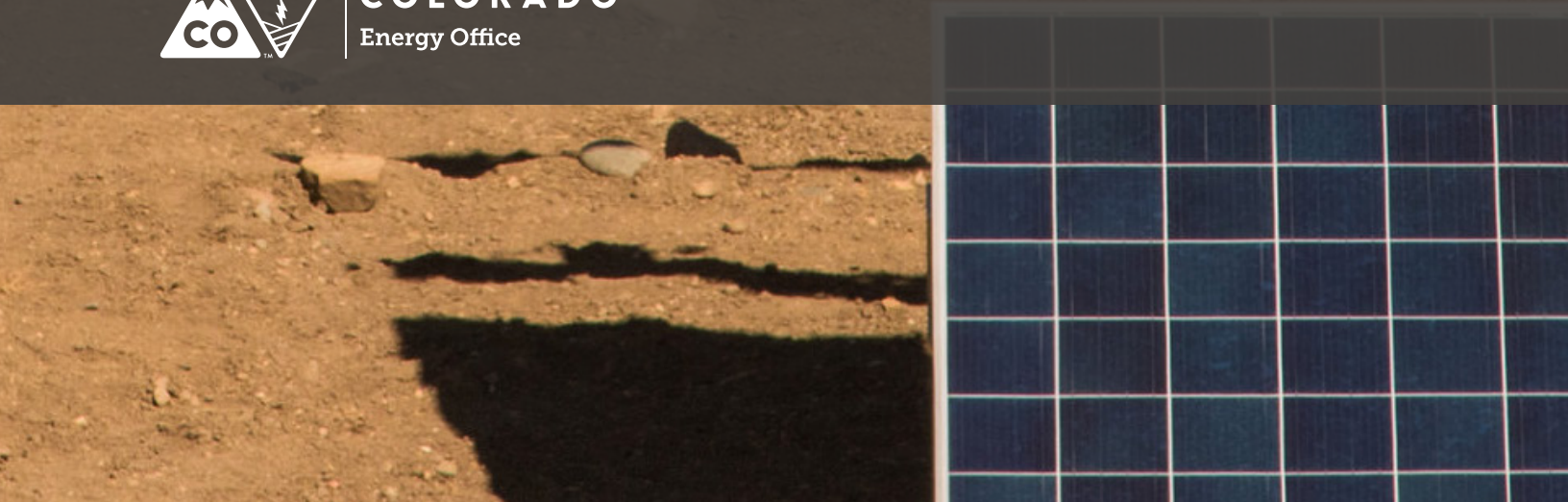
SUBSCRIBER PAYMENT STRUCTURE

- Costs and credits for 2017:
  - Retail rate $0.135/kWh
  - Monthly fixed charges ~$18
  - Solar credit rate $0.053/kWh (with approximately a 3 percent escalator)
  - Subscriber solar payment $0.01/kWh (no escalator)

Low-Income Community Solar Demonstration Project Case Study: Yampa Valley Electric Association

SEPTEMBER 2017

COLORADO
Energy Office



Project Details

Yampa Valley Electric Association's Demonstration Project Highlights

- The project supports YVEA's goal to produce more electricity locally.
- Subscribers are capped at 5.3kW due to the small size of the system, which will allow for an average project cost savings of 42%.
- On average, subscribers will realize annual cost savings of $360, and when combined with average cost savings of $200 from CEO's WAP, subscribers could see annual savings of $560.
- YVEA will work with GRID, CEO's weatherization assistance program and local partners to ensure that clients receive energy efficiency education and services.

INTRODUCTION

Approximately 30 percent of Colorado households pay more than 4 percent of their annual income on energy bills. Although several financial assistance programs exist to relieve high energy burden for low-income households, additional opportunities remain to achieve deeper cost savings by specifically targeting reductions in electricity costs.

The Colorado Energy Office's (CEO) Weatherization Assistance Program (WAP) is dedicated to improving energy affordability for low-income households. Guided by this commitment and in response to a gap in electricity cost reduction programs, CEO launched the Low-Income Community Solar Demonstration Initiative in 2015. The Yampa Valley Electric Association demonstration project is part of the statewide initiative that aims to reduce electricity costs for low-income households by offering community solar options to households that are eligible for weatherization services.

OBJECTIVE

The demonstration project has eight utility partners, including the Yampa Valley Electric Association (YVEA), a co-operative utility that provides electric services for more than 19,924 residents and businesses located in Eagle, Grand, Routt, and Moffat counties. This case study describes YVEA's income-qualified community solar project and informs utilities, governments, and policy makers how community solar projects can impact low-income communities.

PROJECT PARTNER ROLES

YVEA partnered with CEO and GRID Alternatives (GRID) to develop a 165-kilowatt (kW) community solar array that will support up to 45 low-income co-operative members at a time. The primary goal of the project was to reduce costs for low-income households and increase the amount of local renewable energy on YVEA's grid.

Each partner played a key role and will continue to play a key role moving forward:

- CEO identified the demonstration project opportunity and provided funding support and project evaluation.
- GRID developed the design and implementation framework; designed and led the installation of a new 165 kW system; provided everything "behind-the-meter" including all equipment panels, inverters, balance of systems, and labor; developed the workforce training program; and provided communication and outreach support. GRID will maintain equipment warranties.
- YVEA provided funding support, the land and interconnection, conducted outreach, and managed subscriptions. YVEA will provide program administration, maintain full ownership, and conduct all operation and maintenance (O&M) activities.

PROJECT IMPLEMENTATION

In 2014, YVEA partnered with a private company to offer community solar to YVEA subscribers. In the model offered by the company, subscribers paid for panels upfront and were dependent on high solar production to ensure that their investment was returned. While the project was popular, in the first year, production was low due to weather and many subscribers were surprised by their minimal returns. In addition, with this model, YVEA had little control over what was offered. As such, YVEA was interested in pursuing another community solar project but wanted to own the array, offer more consistent returns, and have more control over how the project was implemented.

In 2015, GRID approached YVEA to see if they would like to take part in the demonstration project. YVEA was interested because they would own the solar and it would support low-income residents. In addition, YVEA was interested in the ability to produce energy locally.

"YVEA is proud to help develop a renewable energy project that touches so many people. This project is a perfect pilot for YVEA-owned solar generation—allowing a portion of our membership that often can't access renewable energy to benefit at an affordable cost, helping students and trainees who are building careers in the industry, and bridging what is sometimes a divide between solar advocates and utilities. We believe that many 'right' answers exist for the future of energy, and we expect to embrace varied and innovative fuel choices." – Diane Johnson, YVEA CEO

During the summer of 2016, the demonstration project was approved by YVEA's Board. The community solar array was interconnected into YVEA's grid in November 2016. Subscribers were selected in October and November, with 80 percent subscriptions achieved by December. Due to lower-than-expected production in the previous community solar project, YVEA decided not to fully subscribe their model the first year to ensure that the array was performing correctly. In 2018, YVEA plans to subscribe the remaining 20 percent. Current subscribers received their first financial benefit in April 2017.

YVEA may refer subscribers and deny subscriptions due to poor credit history, history of unpaid bills, and/or illegal activity. YVEA has committed to providing subscriptions for 20 years, with individual subscriptions lasting 5 years.

The project was implemented using a turnkey installation in a "barn-raising" community development model, where subscribers donated 16 hours of sweat equity and worked alongside GRID, Girl Scouts, and YVEA. The panels were installed on YVEA property and interconnected directly to YVEA's electric grid.

ENERGY GENERATION

Before the project, much of YVEA's staff had little to no experience operating and maintaining renewable energy systems. GRID helped train YVEA staff and helped them understand their new role as a generation utility and the additional responsibilities that come with that role such as advanced billing.

Also, due to the array's small size, it is recognized as a qualifying facility under Public Utility Regulatory Policies Act (PURPA). A qualifying facility can either be a small power production facility (under 80 MW) or a cogeneration facility. Since the array was a qualifying facility, YVEA was not required to have Xcel Energy' s permission to install an array.

PROJECT COSTS

The project cost $333,416, with $225,000 covered by CEO's grant and $108,416 contributed by YVEA. Direct project costs included operations (such as equipment, construction materials and GRID staff time), outreach, and administration. Operations accounted for approximately 94 percent of total project costs, while outreach and administration accounted for approximately 5 percent and 0.05 percent of project costs, respectively. YVEA was able to cover all costs from internal funds and provided in-kind support including billing software, ongoing program administration, and the donation of land. YVEA expects that it will take 24 hours of administration time annually to run the program, which will keep administration costs to a minimum.

The total cost per watt was slightly lower than CEO's other low-income community solar demonstration projects since the array was larger than most other projects, which optimized economies of scale.

PROJECT PRODUCTION

The estimated annual kilowatt hour (kWh) production of the solar garden was modeled using PVSyst. Long-term degradation is assumed to equal 0.7 percent per year. In Year 1, the system is expected to produce 198,612 kWh. Actual production data from November 2016 through June 2017 shows that the system produced 106,729 kWh, while estimated production during that same period was 112,501 kWh. During this timeframe, the system has produced 5 percent less electricity than expected.

Note that in November and December 2016, the solar array was being commissioned and some parts needed to be replaced leading to significant underproduction during those months. Since then, most months have shown that the array is performing well above expected. If you only include January through June of 2017, the system has produced 13 percent more electricity than expected.

PROJECT OUTREACH

YVEA and GRID used a variety of marketing platforms including program brochures, mailers, promotion on YVEA's website, and direct outreach to members. YVEA and GRID also hosted several informational workshops where attendees were asked to bring their 2015 Federal Income Tax Return or other proof of income and a recent YVEA energy bill. In order to qualify, subscribers had to be in good standing with YVEA and have a total household income at or below the 80 percent United States Department of Housing and Urban Development defined Area Median Income (AMI) levels for their corresponding county (Eagle, Grand, Moffat, or Routt). At the end of the workshop, attendees could sign up.

"YVEA wanted to ensure that solar was available to everyone. Historically solar was perceived to be a rich person's game. This project allowed everyone to benefit."
– Diane Johnson, YVEA CEO

GRID made direct phone calls to various members and targeted households that had previously benefited from CEO's weatherization services.

Since the Sustainability Council is a trusted organization by many low-income households in the community, it helped market the YVEA community solar array, in addition to its energy efficiency programs.

SUBSCRIBER STATISTICS

When fully subscribed, the 165-kW solar garden will serve around 45 subscribers, with each utilizing varying amounts of solar energy from the garden. In 2017, system sizes range from 3.18 kW to a maximum of 5.3 kW, with an average system size of 5.2 kW. In future years, this range may change. Subscribers will receive benefits for a five-year period and can reapply for participation in the future.

Originally YVEA had hoped to offset an average of 70 percent of each household's electricity use, based on the subscribers' previous 12-month electricity consumption. However, many subscribers used electric heat which drastically increases electric demand. For example, the range of annual electricity used by subscribers ranged from 2,380 kWh/year to 23,855kWh/year. To offset 70 percent of an electric-heated household demand, YVEA would have had to allocate a much larger amount than the 5.3 kW maximum.

COST STRUCTURE

The subscriber pays YVEA the retail rate for electricity consumed plus fixed monthly charges of $27.50 each month. Fixed charges include a monthly base charge. In return, YVEA provides a bill credit to subscribers for the electricity produced by their panels.

The 2017 base residential retail rate is $0.08321/kWh and is expected to increase every year. Subscribers will pay YVEA $0.03/kWh for solar electricity consumed plus fixed monthly charges of $27.50. The bill credit is the difference between the retail rate and the amount YVEA is charging subscribers for solar electricity ($0.03/kWh). In 2017, the bill credit is $0.05321. The solar payment will remain fixed for the term of the contract. This provides subscribers insulation against rising electricity costs and helps subscribers budget for long-term energy costs.

"A steady bill is as important as a low bill." – Diane Johnson, YVEA CEO

On average, YVEA's project is expected to save each subscriber approximately $360 each year. Assuming average annual electric costs of $988, this community solar garden, when combined with potential cost reductions of $200 achieved through CEO's WAP, could reduce low-income subscribers' annual energy costs by approximately 57 percent.

YVEA'S NEXT STEPS

The community solar project is part of a larger plan to increase the amount of renewable energy and clean fuels on the grid to meet subscribers' demand for a more diverse energy portfolio. YVEA noted that if this project succeeds, YVEA would be interested in creating another low-income community solar project. YVEA also will continue to encourage and deploy energy efficiency technologies throughout their territory.

Subscriber Spotlight: Julie Carey

Julie Carey runs a successful daycare center out of her house and at any given time she has up to five kids running, playing, and sleeping. Her students' comfort is her utmost priority; however, keeping her house at a comfortable temperature proved to be an expensive struggle. Her 1929 house was built with no insulation, and older windows all of which lead to especially expensive utility bills during the cold Steamboat Springs winters.

With the reduced natural gas costs that came from energy conservation measures, Julie, a self-proclaimed environmentalist, was curious about ways to further reduce costs and the environmental impact through renewable energy. Julie heard about the YVEA community solar program through the community newspaper and the Yampa Valley Sustainability Council. She signed up right away since the program would save her money, support the local economy, and help the environment.

After speaking with a GRID representative, Julie believed she could see significant electricity savings of between 30 percent and 50 percent a year by participating. These cost savings are extremely beneficial to her and her students.

"The more renewable energy the Valley can produce locally and conserve the better. There is a large demand for locally sourced renewables."
-Julie, Subscriber

While the marketing for the community solar project was strong, the sign-up process was not. Julie did not hear whether she was part of the program for multiple months after completing her paperwork. In addition, there was a large gap between signing up in November and receiving credits in April. Otherwise, Julie is thrilled to be part of the program and stated the process was smooth.

HCE SUBSCRIBER: JULIE CAREY

Estimated Versus Actual Performance

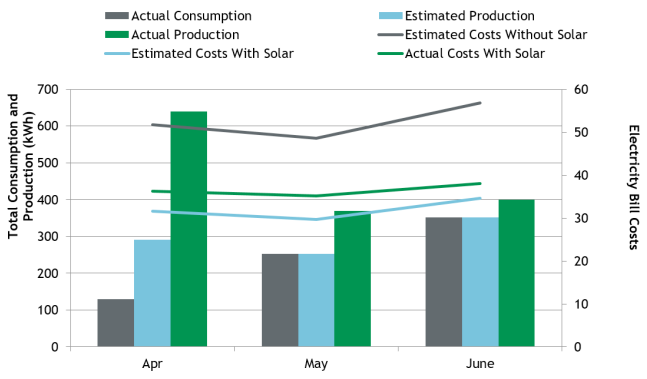
In 2016, Julie's household used 3,749 kWh and spent $307.99 on electric bills. To offset usage, Julie's household was allocated 2.65 kW of solar energy. Julie expected the solar to offset approximately 100 percent of her electricity usage and about 30 percent of her costs.

In the first full 3 months of benefits she saw over 100 percent of her electricity usage offset and her electricity costs offset by 22 percent. The remaining 78 percent of costs on their bill was from the fixed monthly costs and the $0.03 she pays per kWh to participate in the program.

Julie's final electricity costs and savings from participation in the program are a factor of the fixed fees that YVEA charges and the actual consumption of electricity in her household. On the first 3 months of the program Julie's normal electricity costs would have been $126.66. Of that $126.66, $72 is fixed fees which are not affected by the community solar program. The remaining $54.66 is the cost of electricity consumed by Julie which is effected by the community solar program. Since only 43 percent of Julies costs are related to consumption, the program can only make a limited impact on Julie's costs.

In future months Julie will experience significantly more savings since she uses more electricity during the fall and winter for heating; therefore, her consumption makes up a larger percentage of the bill compared to fixed fees. In addition, the YVEA community solar program allows Julie to roll over kWh credits from one month to the next. Julie can get credits by consuming less electricity then the allocation of the solar array produces. Therefore, any credits she accumulates can be attributed to future, more expensive energy intensive months. As of June 2017, Julie had accumulated 514 additional kWh of solar credits that will be applied to future months.

FIGURE 1: ESTIMATED VERSUS ACTUAL PRODUCTION FOR JULIE CAREY



Lessons Learned

SUCCESSES

- The project has low operating costs and minimal O&M.
- The project supports YVEA's goal to produce more electricity locally.
- Subscriber electricity costs were reduced.
- The project provided much needed renewable energy experience to YVEA staff members.
- Lower electricity costs will help reduce the number of non-payments that YVEA will receive.
- When coupled with weatherization assistance program savings, this project has the potential to reduce energy costs by approximately 57 percent.

CHALLENGES

- Even with the CEO grant and GRID's support, it was difficult to provide maximum benefit to subscribers while balancing utility costs.
- YVEA's staff had a lack of experience with installing renewable energy systems.
- The qualification process took multiple months.

PROGRAM CONSIDERATIONS

YVEA's case study provides insight on how to optimize future low-income community solar garden projects.

Utility local, trusted organizations. Since the Sustainability Council is a trusted organization by many low-income households in the community, it helped market the YVEA community solar array, in addition to its energy efficiency programs.

Set a realistic expectation of savings. YVEA believes that you must provide a realistic expectation of cost savings from the program upfront. They would recommend having a calculator during the qualification process to make sure each household has an accurate estimate of savings. Subscribers for the project had expected savings ranging from 16 percent to 74 percent.

Put a cap on the amount of solar each participant can subscribe to. Due to the small size of the array, YVEA thought it was important to put a cap on how much solar each participant could be allocated. For example, to offset 70 percent of one participant's electricity demand, YVEA would have had to allocate 12.43 kW (more than 7.5 percent of the total array) instead of the capped 5.3 kW to that household. By keeping the distribution small, more households can benefit.

Install the array on utility-owned land. Installing the array on land owned by the utility and adjacent to utility headquarters can simplify interconnection and help to save costs.

Ensure consistent communication and expectations with subscribers. There were several lengthy delays because communications with subscribers left subscribers confused as to understanding whether the program was still moving forward. More consistent communication would have made the process smoother.

POLICY CONSIDERATIONS

Lessons learned from the YVEA community solar garden present the following policy considerations:

Fixed charges play a significant role in the potential for reducing energy costs. Community solar incentives are typically provided as bill credits – credits on utility bills – and are issued as a dollar per kWh amount at a value less than retail rates. Fixed charges are not affected. While a subscriber's bill will be reduced by the bill credit amount, the subscriber will always be responsible for paying fixed charges. The degree to which a subscriber's energy costs are reduced is a direct function of the amount of fixed charges relative to the cost of electricity. In YVEA's solar model, subscribers have a monthly fixed fee of $27.50. This can lead to lower cost savings.

The solar payment structure affects subscriber's total cost savings. The amount that each subscriber pays to participate in community solar and associated escalation rates affect the subscriber's total savings. YVEA solar payments do not escalate even though electricity retail rate costs do. Therefore, the savings will grow over time as the solar payments stay constant and the retail rate increases. For example, YVEA subscribers in 2017 will save $0.05321 per kWh, while subscribers in 2037 could save approximately $0.09122 per kWh.

Capping the size of a subscriber's portion of the project will affect high-electricity user's potential savings. YVEA capped every subscriber at the less of 100 percent of their previous 12-month electricity use or 5.3kW. One subscriber's consumption would require a 17.7-kW system allocation using that sizing guidance. In return, the subscriber received only a 24 percent reduction in costs during the first month.

Project Snapshot

QUICK STATISTICS

- 165 kW solar garden
- Maximum 45 subscribers
- 80% subscribed
- All subscribers are eligible for WAP

UTILITY TYPE

- Co-operative
- Serves over 19,924 residents and businesses located in Eagle, Grand, Routt, and Moffat counties
- Receives wholesale electricity from Western Area Power Administration and Xcel Energy

ENERGY BURDEN

- Approximately 8% of residents in Eagle County, 8% in Grand County, 12 percent in Moffat County, and 9% on Routt County live below the poverty line, compared to a statewide average of 12%.

PROJECT GOALS

1. Reduce members' energy costs
2. Provide a local, resilient electricity source
3. Provide locked-in energy prices
4. Provide renewable energy and diversify energy supply
5. Enable YVEA staff to get hands-on experience

PROJECT PERFORMANCE

- On average, project expects approximately 42% cost savings and 70% electricity offset by solar
- Expected to produce 226,254 kWh annually
- To date, the system has produced 5% more electricity than expected.

PROJECT COSTS

- Total project cost: $333,416
- CEO grant: $225,000
- YVEA contribution: $108,416, plus in-kind support

SUBSCRIBER PAYMENT STRUCTURE

- Costs and credits for 2017:
  - Retail rate $0.08321/kWh
  - Monthly fixed charges $27.50
  - Subscriber solar payment $0.03/kWh

10. APPENDIX B: ALTERNATIVE UTILITY PROJECT STRUCTURES FOR SOLAR

Under the utility-led low-income approach, the generation from the PV systems is used to credit low-income subscribers' bills. Although providing an electricity bill credit to an entire low-income customer class would be a more direct approach to reducing the energy burden of low income customers, many of the utilities interviewed indicated that the community-based solar approach had several qualitative advantages over a straightforward electricity subsidy. Foremost, a direct subsidy to low-income subscribers is not always allowed as a matter of regulatory policy, since it can be perceived as a cost-shift to other ratepayers. Lastly, many utilities viewed community-based solar for low-income households as an opportunity to include a group of ratepayers who had traditionally paid for solar programs which predominantly benefited higher income households (due to upfront capital requirements).

Yet, many of the participating utilities interviewed at the end of the projects indicated that they may not pursue future low-income community solar projects without additional project grant funding, citing weak project economics as a key factor in their hesitance to pursue further projects. Two potential approaches to improve low-income project returns include a utility-led PPA-based low-income approach, and a third-party-led dedicated low-income approach. These two models are explored below:

10.1 Utility-Led PPA-based Low-Income Approach

Under this project, all but one of the utilities directly purchased the PV systems, and were unable to utilize the federal ITC and MACRS incentives, due to their non-taxable status and size of the systems they were interested in developing. If a similar system purchase approach had been adopted by an IOU, where the IOU could utilize the tax incentives, the overall utility return may be much more favorable. Based on a Greentech Media Community Solar Outlook report for 2017, IOUs are expected to comprise the majority utility-led community solar in the near term, due in part to these advantages, and their ability to procure large-scale PV projects.[lii] It is important to note that this growth is projected in a small subset of states; in many deregulated states, utilities are not allowed to own generation, preventing utility-led community solar development. However, co-operatives and municipal utilities remain a significant addressable market, albeit one with more challenges.

Although non-taxable utility low-income solar may be a more challenging economic case, one potential approach to improve the return on co-operative-led, dedicated low-income projects could be to contract for a PPA with a third-party system owner that is able to take advantage of the federal tax incentives. One advantage of this approach would be that the utility would avoid a large upfront cost for the system and instead pay a certain rate for the solar generation. Then, based on the PPA rate, the utility could establish a bill credit rate that meets their customer savings and overall return objectives.

Given that low-income customer rates must generally be fairly low (between $0.01-$0.04 per kWh in the case of the projects studied) in order to achieve 30-50 percent utility savings, a utility would likely still purchase the solar generation under the PPA at a higher rate than the low-income customer payments. However, the net-present cost of this PPA shortfall may still be smaller than the net-present cost of a system purchase. Under this model, the utility could still manage the low-income customer acquisition, billing, and retention using a similar approach to that adopted in the current projects.

Finally, in certain states with higher utility rates, such as Hawaii, this approach might even allow for a utility to acquire the solar generation at a lower rate than the low-income solar payment required to achieve 50 percent utility bill savings. This approach may be subject to regulatory limitations, but could potentially accomplish the project objectives more cost-effectively for co-operatives pursuing dedicated low-income projects in the future.

10.2 Third-Party-Led Low-Income Solar

The current utility projects focused on reaching 100 percent low-income subscription, which impacted a much broader number of low-income customers, but also required additional grant funding to be viable. In addition to the dedicated, 100 percent low-income approach pursued under this project, there are other, private third-party-owned approaches to low-income participation in the United States, with the most common including:

- Carve-outs: Required low-income subscriber participation levels of 5 to 20 percent of the system capacity for all community solar projects
- Subsidies: Incentives for solar systems for low-income households (low-interest financing, developer incentives for including low-income households)

Currently, there are five major state markets expected to drive the majority of third-party-led community solar: Colorado, Massachusetts, Minnesota, New York, and Maryland. These programs are typically characterized by the development and ownership of the project by a non-utility entity that sells electricity and renewable energy credits to a utility, and passes on utility bill credits to subscribers.

Although these projects have not generally included 100 percent low-income members, they could still potentially impact a large number of low-income households, due to the greater scale of these projects. As an example, a 1000 kW project that earns a project return and includes low-income subscribers as 20 percent of its subscriber base could potentially impact a similar number of households as a 200-kW system dedicated solely to low-income subscribers. An advantage of this approach is that it allows a project to include a mix of higher-income subscribers who may be willing to pay more for their shares, with low-income subscribers, potentially obviating the need for subsidies to make a project economically viable. One disadvantage of a carve-out approach is that third party developers can struggle to find enough low-income subscribers for each project to meet their low-income targets. A novel approach adopted in Colorado was a transition to a project portfolio-based approach that allowed a third-party community solar owner to subscribe more low-income households to certain projects that could support the low-income subscriber discount, and less on others.[26]

26 For more information see: *Analysis Of The Fulfillment Of The Low-Income Carve-Out For Community Solar Subscriber Organizations* by Lotus Engineering and Sustainability (https://www.colorado.gov/pacific/sites/default/files/atoms/files/CEO%20Low-Income%20Community%20Solar%20Report.pdf)

11 APPENDIX C: ADDITIONAL FIGURES

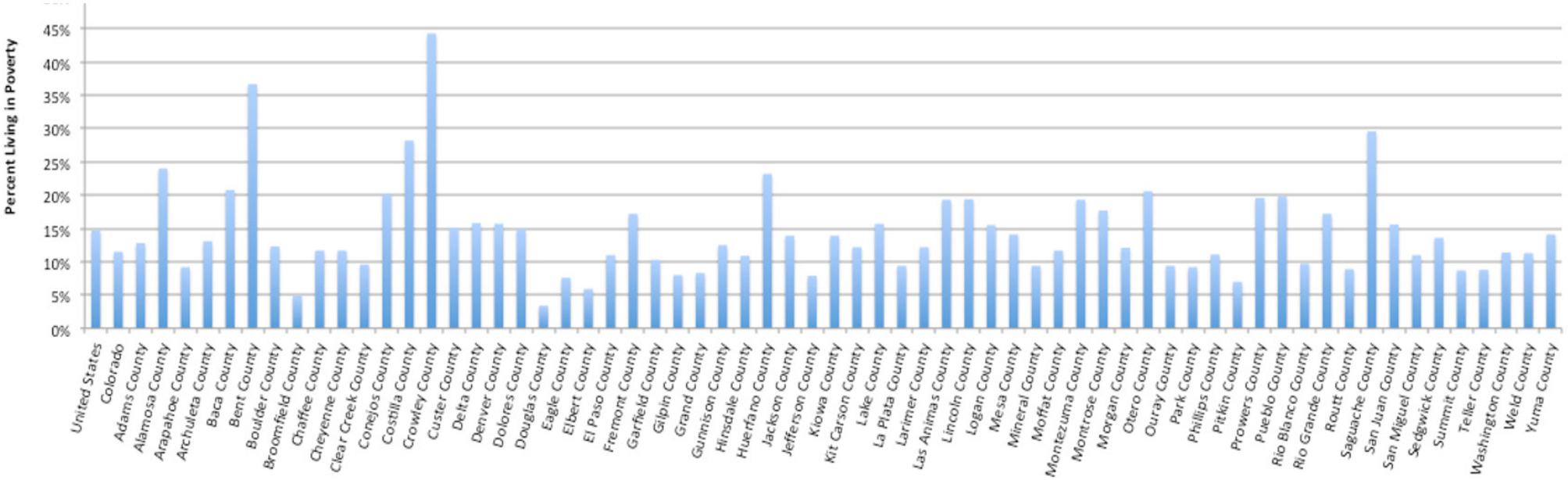


FIGURE 2: PERCENT OF COLORADO RESIDENTS LIVING IN POVERTY BY COUNTY[IX]

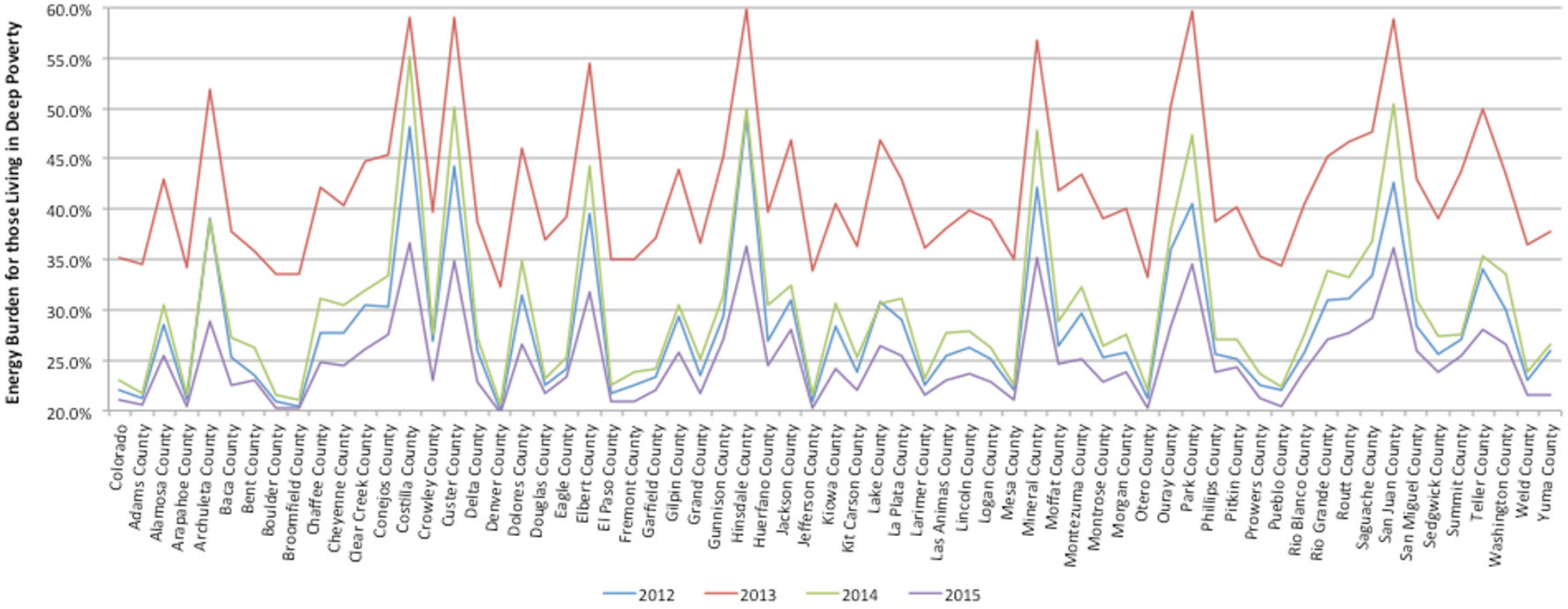


FIGURE 5: ENERGY BURDEN RATES FOR THOSE LIVING IN DEEP POVERTY OVER TIME[xxiv]

12 APPENDIX D: END NOTE REFERENCES

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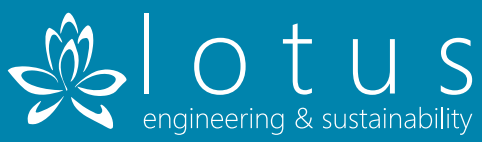

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