SOLAR RISK

How Energy Storage Can Preserve Solar Savings in California Affordable Housing

Wayne Waite, Program and Policy Consultant
Seth Mullendore, Project Director, Clean Energy Group
May 2017

RESILIENTPOWER

A project of CleanEnergyGroup

ABSTRACT

This paper, one in a series of reports by Clean Energy Group and Meridian Institute on advancing resilient power in low-income communities, presents analysis assessing the negative impacts of changes to net metering policies and proposed utility rate tariffs on the bill savings achieved by solar for both property owners and tenants of multifamily affordable housing in California. The paper also explores the role of energy storage in reversing anticipated losses to the value of solar.

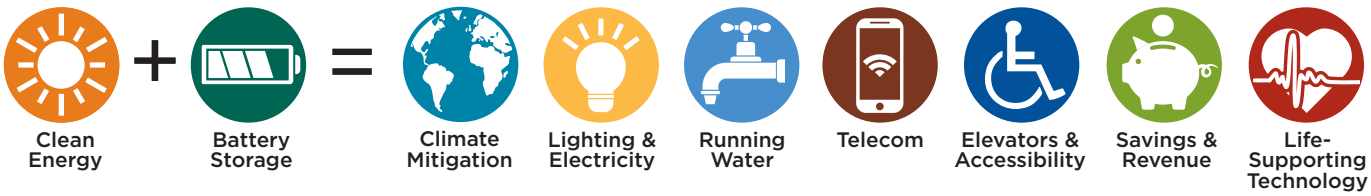
ACKNOWLEDGEMENTS

This report was prepared as part of the Resilient Power Project, a joint project of the Clean Energy Group (*www.cleanegroup.org*) and Meridian Institute (*www.merid.org*). This project works to expand the use of clean distributed generation for affordable housing and critical facilities to avoid power outages; to build more community-based clean power systems; and to reduce the adverse energy-related impacts on vulnerable populations. The authors of this report would like to thank Maria Blais Costello, Lew Milford, and Rob Sanders of Clean Energy Group, and Stephanie Chen of The Greenlining Institute for their contributions and review of this report. The views and opinions expressed in this report are solely those of the authors.

Contents

RESILIENT POWER

A project of Clean Energy Group



RESILIENT POWER | PROTECTING COMMUNITIES IN NEED

Cover photo courtesy of LINC Housing

Executive Summary

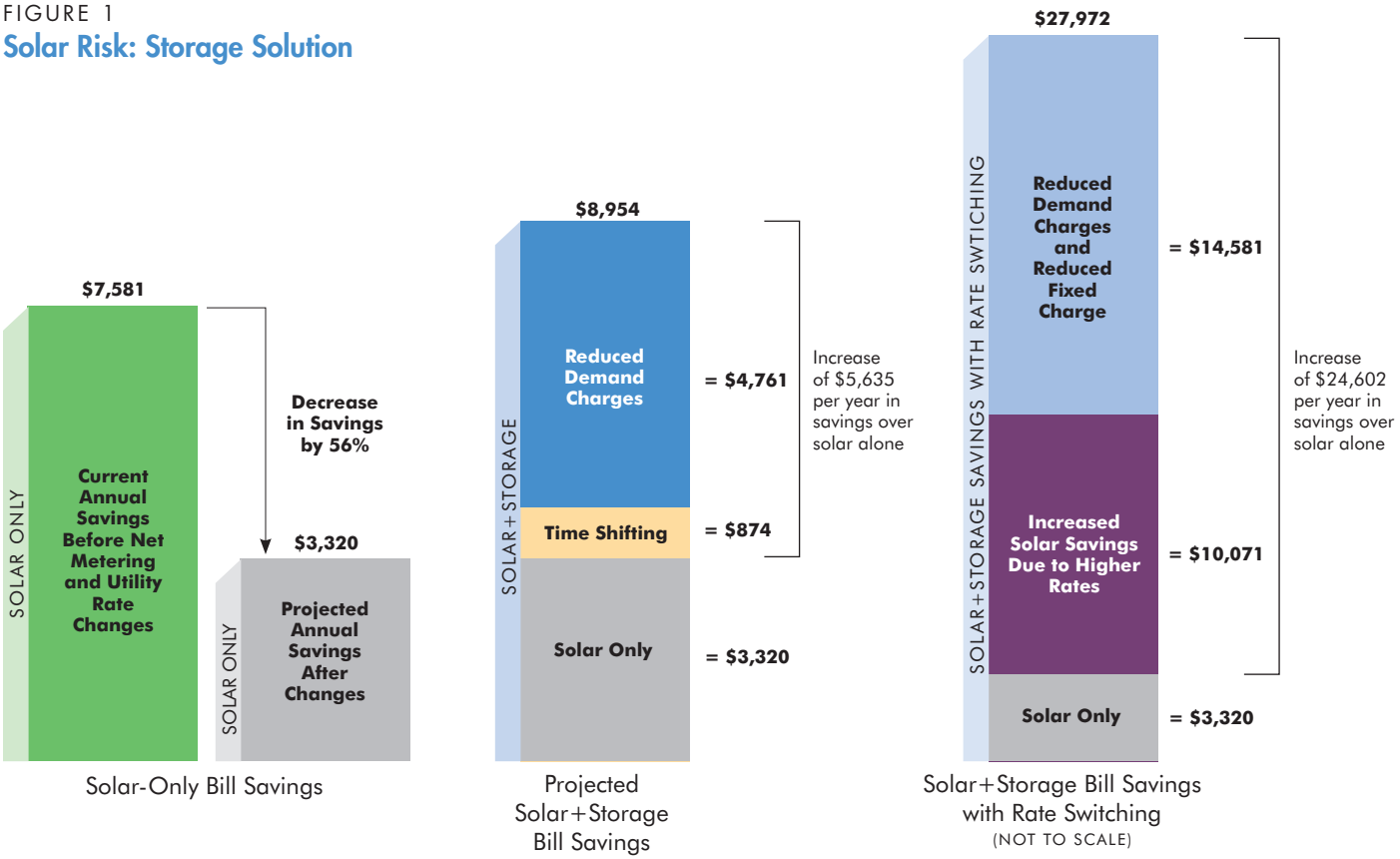
PRESERVING THE VALUE OF SOLAR TECHNOLOGIES FOR LOW-INCOME COMMUNITIES WITH ENERGY STORAGE

JUST AS SOLAR IS BEGINNING TO SERVE more low-income communities, such as in multi-family affordable housing, new ratemaking changes could make those investments especially risky in the future. Nowhere is this more evident than in California, the leader of cutting-edge innovation in clean energy policy.

Recently, utilities and regulators in California proposed policy changes and new electricity rate structures that could drastically erode the value of stand-alone solar. Those changes, through modifications to net metering, time-of-use rates, and demand charges, could hit solar installations in affordable housing especially hard—in some cases, reducing the energy bill savings from solar-only investments by more than 50 percent within the next few years.

This dramatic reduction in the value that solar can deliver creates potential risks to affordable housing owners who have made or are considering solar investments in the state. The good news is that there is a way for property owners to hedge these future financial risks from solar with additional investments in battery storage. As shown in **Figure 1**, storage can deliver additional bill savings to reverse the losses to solar value and, in some cases, even achieve multiple times the savings of solar-alone today.

FIGURE 1
Solar Risk: Storage Solution



Adding energy storage can reverse the negative impacts on solar bill savings due to net metering changes and proposed utility rate tariffs, which could reduce savings by more than 50 percent. Storage unlocks additional savings through time-shifting solar to be used during peak electricity pricing periods and reducing, or in some cases eliminating, demand charges.

This paper details the first analysis of how anticipated net metering policy and utility rate changes could expose the California affordable housing sector's solar investments to these financial risks. The findings are particularly significant as these changes are coming about just as support for low-income solar is about to ramp up with the upcoming implementation of the state's Multifamily Affordable Housing Solar Roofs Program, as authorized by AB 693.

To assess the impact of net metering and rate changes, an analysis was done to tell the story of a representative affordable housing property in San Diego. The analysis makes two important findings: (1) the changes would significantly reduce the value proposition for a stand-alone solar system, and (2) incorporating energy storage could potentially reverse these negative economic impacts.

The analysis is based on an actual 50-unit affordable housing property under a rate tariff that would be widely applicable to medium- to larger-sized commercial properties in the San Diego area. The property and its electricity usage and costs were well known as they were the subject of a previous solar and storage analysis under current rate tariffs. While the analysis is limited to a single property, the sheer magnitude of negative impacts found should serve as a warning sign for the entire sector.

The adverse results for the San Diego property should alert the state's affordable housing owners to the risks that these policy and rate changes can have on solar investments, and to the potential benefits of adopting integrated solutions that include energy storage. Policy makers should also take note of these findings when exploring program and policy options to incentivize solar in affordable housing.

It is important to emphasize that the shifts in policy and utility rates presented in this paper are currently underway in California and are not merely a hypothetical exercise. While these changes may appear to run counter to the state's ambitious renewable energy goals, they are in fact the result of a thriving solar market and a natural outgrowth of successful policies and the state's evolving energy sector.[1]

Therefore, while the results detailed in this paper are specific to California and how these shifts may impact affordable housing in the state, they are indicative of changes already occurring or soon on the way for other leading solar states across the country. In other words, these changes are what the leading solar states can be expected to implement in the years to come. They are the future of solar rate policy, and they indicate that storage may be essential to maintaining favorable solar economics.

Key takeaways from the analysis include:

- Proposed policy and rate changes such as shifting time-of-use electricity pricing periods, the addition of non-bypassable electricity charges, and increases to demand charges in California *could erode electric bill savings from solar investments by more than 50 percent* for affordable housing property owners.
- Affordable housing tenants face many of the same solar risks from the potential reduction in solar values, which could result in a *net economic loss of 29 percent for some low-income residents*.
- Solar systems with *energy storage can be more responsive* to changing utility pricing signals, and can *double* or *even triple the net utility bill savings when compared to solar alone*—effectively reversing the lost value of solar resulting from these changes.
- By increasing annual savings, the addition of energy storage to a solar installation could improve the feasibility of project financing, potentially *boosting project cost coverage by as much as 60 percent*.

Based on these finding, the following actions are recommended:

- A broader survey of the impacts of proposed solar policy and utility rate changes on the economics of solar for the affordable housing sector should be conducted in California.
- Barriers to the greater deployment of integrated clean energy solutions for affordable housing, specifically solar combined with energy storage, must be identified and addressed.
- Incentives for the development of flexible, integrated solutions, like energy storage, should be considered in the design and implementation of any programs with the goal of encouraging the development of solar energy systems in affordable housing, such as California's Multifamily Affordable Housing Solar Roofs Program.

Introduction

A SHIFTING CLEAN ENERGY LANDSCAPE FOR AFFORDABLE HOUSING

A 2016 CALIFORNIA PUBLIC UTILITIES Commission (CPUC) decision on the future of net metering, known as NEM 2.0, ruled to keep much of the program intact.[2] For instance, it kept retail compensation in place for excess solar energy exported to the grid. It also put all California solar customers on the path towards mandatory time-of-use (TOU) electricity rates. TOU rates charge utility customers different prices for the electricity they use depending on the time of day. They also compensate customers for excess solar generation based on when it's exported to the grid. What the decision didn't do was specify what those TOU rates might look like.

In January 2017, the CPUC finally weighed in on the future structure of TOU rates. The CPUC approved guidelines that pave the way for California's investor-owned utilities to shift their highest-price electricity pricing periods later in the day.[3] With the new peak pricing periods expected to shift from midday to early evening for most utility customers, the ruling could have serious implications for the value of solar in the country's largest solar market.

Based on evening peak periods proposed by San Francisco area utility Pacific Gas & Electric (PG&E), the energy consultant Sage Renewables calculated that the value of commercial solar systems in the region could decline 20 to 40 percent.[4] Such a dramatic loss of savings revenue could jeopardize the economics of many existing solar power-purchase agreements, leases, and loans, not to mention significantly curtail the state's booming distributed solar market.

While these impending rate changes will have wide-ranging effects across California's solar landscape, multifamily affordable housing properties may be particularly vulnerable to shifts in utility rate structures. By their nature, affordable housing properties are very sensitive to changes that affect property cash flows.

© Nana Akowuah

This is because the rent incomes and property receipts of affordable housing are restricted by regulatory agreements, and property owners do not typically carry reserves to cover higher utility costs or declines to the expected energy savings returns on renewable investments. Consequently, property owners must be alert to risks that may adversely affect a property's net operating income levels and its ability to meet debt service or payment obligations attributed to solar investments.

This paper takes a deeper look at the impacts that net metering policy and utility rate changes could have on energy investment strategies and solar project feasibility in California's affordable housing sector. Specifically, this paper analyzes the economic effects of TOU shifts, increasing demand charges, and added net energy metering costs. To accomplish this, the analysis tells the story of a representative 50-unit affordable housing solar project under rate structures and peak period pricing changes included in the current San Diego Gas & Electric (SDG&E) General Rate Case (GRC).[5,6] The outcome of this GRC, and rate cases filed by PG&E and Southern California Edison (SCE), will determine what actual peak periods and electricity pricing will ultimately look like.

In addition to assessing the economic effect of these changes on the value of solar to multifamily affordable housing, the analysis also explored the economics of energy storage investments. This was done to determine whether more integrated distributed energy resource strategies could have a role in reversing the declining value proposition of solar investments.

The specific property selected for this new analysis had been previously examined to explore the economics of solar and storage under current utility rate structures, which found highly positive results for both solar and integrated solar and storage solutions.[7] By continuing to tell the story of this same property, it was assured that an accurate picture of the economics before and after implementation of proposed changes could be assessed—a real world test of the proposed new rates.

The intent of the analysis was to flag potential negative outcomes from proposed policy and rate changes to show how they can adversely impact the value of solar, and to highlight these issues for subsequent future analysis.

Since factors affecting utility costs and the valuation of solar will vary from building to building, results presented here are not intended to be representative of all multifamily housing properties in the state, though most medium to large housing properties will face similar changes. Indeed, the results of the analysis can tell us a lot. The magnitude of adverse impacts found for this one property certainly warrant further exploration of the effects on the affordable housing sector, and whether they could jeopardize the financial feasibility of future solar projects.

The intent of the analysis was to flag potential negative outcomes from proposed policy and rate changes to show how they can adversely impact the value of solar.

The implications of these findings are also important for state policy makers and regulators. California regulators are currently preparing to adopt a program design to implement the state's new Multifamily Affordable Housing Solar Roofs program, which could allocate up to one billion dollars for the development of solar energy systems in multifamily affordable housing over the next decade.[8] It is vital to keep energy costs low and controllable for property owners to ensure that properties remain affordable. Property owners that cannot keep up with their energy costs may choose to convert the property to market rate housing at the end of their financing period, which would further exacerbate California's growing housing crisis.

This paper follows a previous economic analysis of solar and storage technologies in California multifamily affordable housing by Clean Energy Group and energy software company Geli, which is detailed in the report *Closing the California Clean Energy Divide* (2016).

The Declining Value Proposition for Solar

AS OBSERVED IN OTHER REPORTS, THIS analysis of affordable housing economics confirmed that the value of stand-alone solar PV would dramatically decline for property owners under new TOU periods and additional changes proposed by California utilities.[9] SDG&E and SCE have both proposed shifting the peak pricing period (the highest priced electricity period) to 4 pm to 9 pm, while PG&E has proposed an even later peak pricing period from 5 pm to 10 pm.

The effect of SDG&E moving its summer peak from the current period of 11 am to 6 pm to a later period of 4 pm to 9 pm can be clearly seen in **Figure 2**, which shows the solar generation profile for a typical PV system in San Diego during August, along with current and proposed TOU peak pricing periods.[10] Not only do the proposed changes shift the peak period to the evening, they also narrow the peak period from 7 to 5 hours, giving customers less opportunity to maximize their solar value.

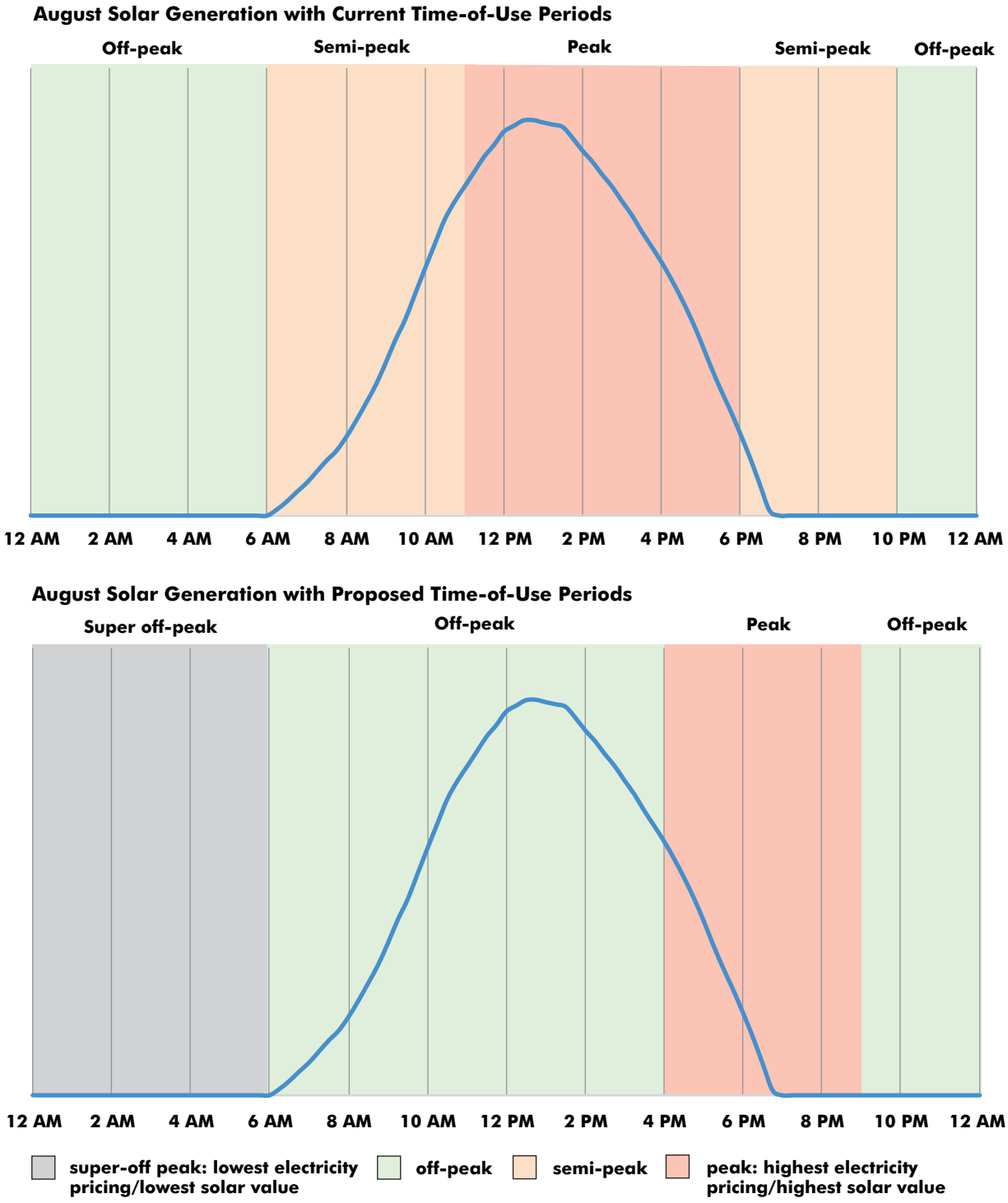
In San Diego, about 46 percent of annual solar generation occurs during the current TOU peak pricing period. The rest falls within the semi-peak period, earlier or later in the day, which has slightly lower electricity prices and lower solar savings potential. During August, when solar generation is at its highest, on-peak energy production rises to over 70 percent.

The solar value potential is starkly different under SDG&E's proposed TOU periods. A solar system in San Diego would only produce about 23 percent of its electricity during peak pricing hours throughout the year, with the rest being consumed or exported to the grid during the low-priced, off-peak period. This means that most solar energy would be used or exported when it is worth significantly less to the solar property owner.

Based on the analysis of solar for the San Diego multifamily affordable housing property, the upcoming shift in TOU periods would result in a reduction of solar value of at least 14 percent for the property owner.[11,12] More significant, however, is the combined economic effect of solar TOU devaluation along with added non-bypassable charges and proposed increases to demand charges. As shown in **Figure 3**, the combination of these three factors

FIGURE 2

Impacts of Proposed TOU Changes and Shift of Peak Pricing Periods



Changes to time-of-use periods proposed by California's investor-owned utilities would have a significant impact on the amount of solar consumed or exported during peak periods, when electricity prices and the value of solar are at their highest. These graphs show how August solar generation for a typical PV system in San Diego would correlate with current and proposed San Diego Gas & Electric summer weekday time-of-use pricing periods. Under the current structure, more than 70 percent of solar electricity would be produced during the high-priced peak period from 11 am to 6 pm. Under the proposed structure, the majority (over 70 percent) of solar production would occur during the lower-priced, off-peak period from 6 am to 4 pm.

Source: https://www.californiasolarstatistics.ca.gov/data_downloads

would reduce solar electricity bill savings for a multifamily affordable housing property by an estimated 56 percent.[13]

Imposing non-bypassable charges for solar generation was approved as part of the CPUC's NEM 2.0 decision. These non-bypassable charges are small per kilowatt-hour fees for items like public purpose programs and nuclear facility decommissioning. The charges are applied to any electricity purchased from the utility, even electricity that is offset by solar net metering credits. So, any solar energy that is exported to the utility and later consumed will incur non-bypassable charges.

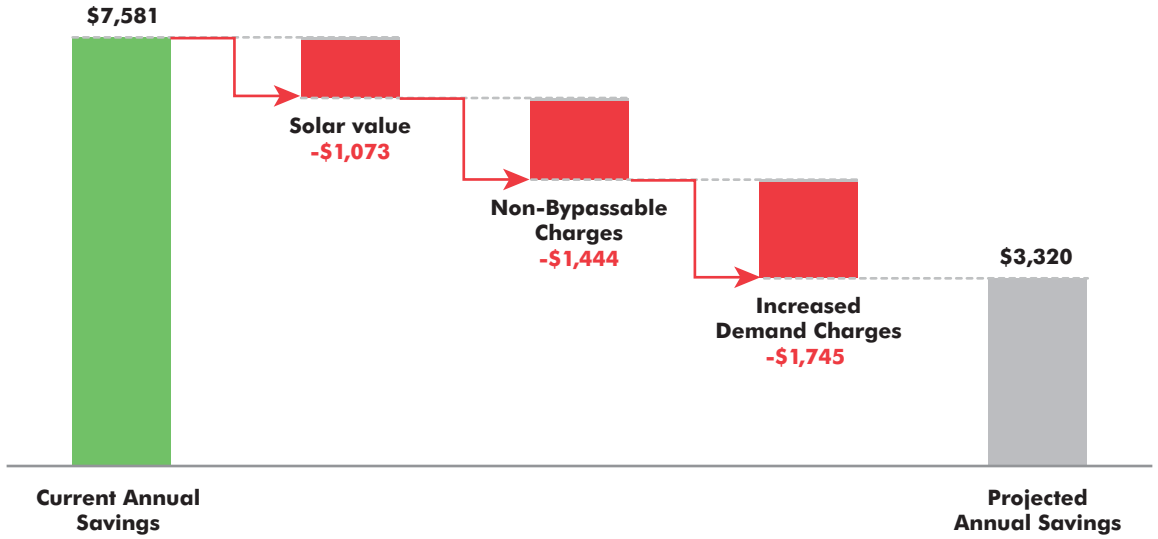
For SDG&E these charges amount to about 2 cents per kilowatt-hour. While that may not sound like a lot, the analysis found that non-bypassable charges would reduce the value of solar for a San Diego area affordable housing project by 19 percent under new TOU structures. SDG&E hit its original net metering cap in June 2016, so properties with approved interconnections after this date will be subject to non-bypassable charges under NEM 2.0.

Increases to demand charges that have been proposed by SDG&E in their current GRC will further impact property operating costs. The proposed increases were found to have the most significant impact on the overall bill savings, decreasing savings by 23 percent.[14] Demand charges, which are based on the highest level of electricity demand during each billing period, are incurred by most medium to large commercial customers, including multifamily affordable housing properties. It is important to note that increases to demand charges in California have significantly out-paced increases to electricity usage charges. Since 2005, year-over-year increases in demand charges for the state's three investor-owned utilities are respectively 7.7 percent (SCE), 11.5 percent (PG&E), and 16.6 percent (SDG&E).[15]

The combined magnitude of anticipated losses to bill savings because of these three factors could seriously impact the economic feasibility of new, and many existing, solar projects at multifamily affordable housing in California.

FIGURE 3

Proposed Changes Reduce Property Owner's Annual Savings from Solar by $4,262, a 56% Loss



The combined impact of shifting time-of-use pricing periods, non-bypassable charges, and proposed higher demand charges would reduce the annual bill savings delivered by a commercial solar system in San Diego by 56 percent. The annual savings shown in this chart represent a 52-kilowatt PV system producing 75,000 kilowatt-hours per year for an affordable housing property with an annual peak demand of 35 kilowatts billed under the San Diego Gas & Electric TOU-AL rate tariff.

A Growing Role for Energy Storage in Offsetting Solar Losses

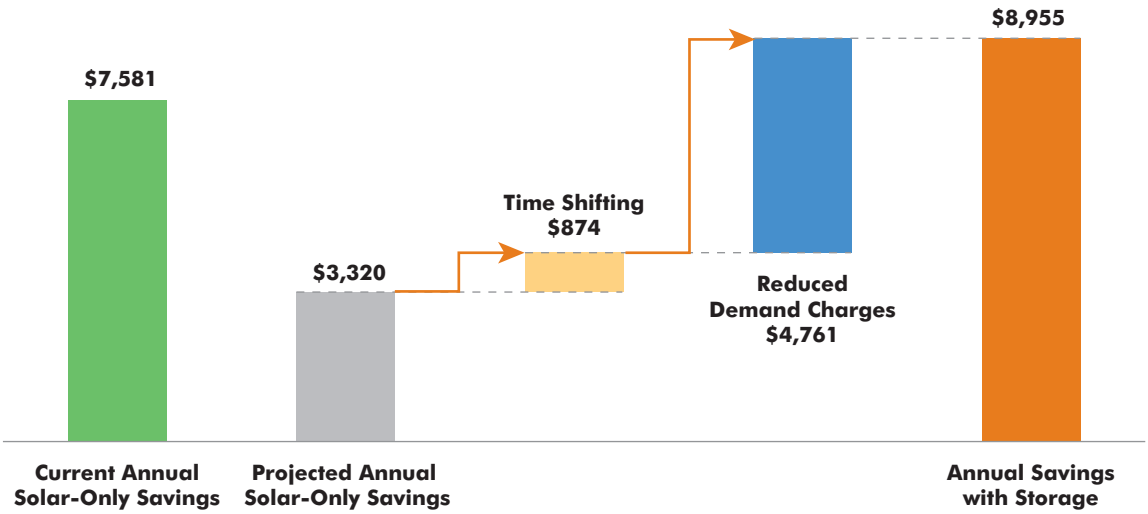
IN THE COMING REALITY OF EVENING PEAK pricing periods and increased utility charges, energy storage has emerged as a tool to preserve and enhance the value of solar. This paper explores three potential revenue streams that storage could unlock when incorporated with solar: time-shifting solar energy use under TOU rates, reductions to demand charges, and switching utility rate tariffs by limiting peak demand. Additional storage value streams, such as providing utility and grid services and powering critical loads during emergency outages, were not analyzed but could deliver significant added value to any project.

The economic results of adding storage to a solar system, shown in **Figure 4**, found that solar time-shifting and demand charge management could more than offset the anticipated losses to solar-only bill savings.[16] With storage, the resulting annual bill savings of about $9,000 represent an 18 percent increase in savings over current solar-only system savings and nearly three times the estimated solar-only savings under SDG&E's proposed rate changes. Most of these gains result from reductions to demand charges, which solar cannot dependably target without incorporating the added flexibility of storage.

Savings through time-shifting solar energy use from lower-cost, off-peak pricing periods to higher-cost, peak pricing periods are less significant, about 15 percent of the added bill savings. This is because the difference between peak and off-peak pricing under SDG&E's TOU-AL rate tariff is relatively small, less than 4 cents per kilowatt-hour. Because of this small difference in pricing, the revenue potential from TOU period shifting by itself is an unlikely driver for investing in storage at this time. For smaller

FIGURE 4

Storage Provides Property Owner with More Savings than Solar Alone, an Increase in Savings of $5,635 per year



Adding a 60-kilowatt/90-kilowatt-hour battery system to the 52-kilowatt PV system analyzed in Figure 3 can completely offset the loss in solar bill savings due to proposed rate changes (represented by the difference between current [green] and adjusted [grey] annual saving). The combination of reduced demand charges and shifting solar use from low-cost to high-cost electricity periods increases annual savings by more than $5,000, with over 85 percent of the savings coming from reductions to demand charges.

multifamily affordable housing properties on SDG&E's TOU-A rate tariff, the potential value of solar time-shifting is greater.[17]

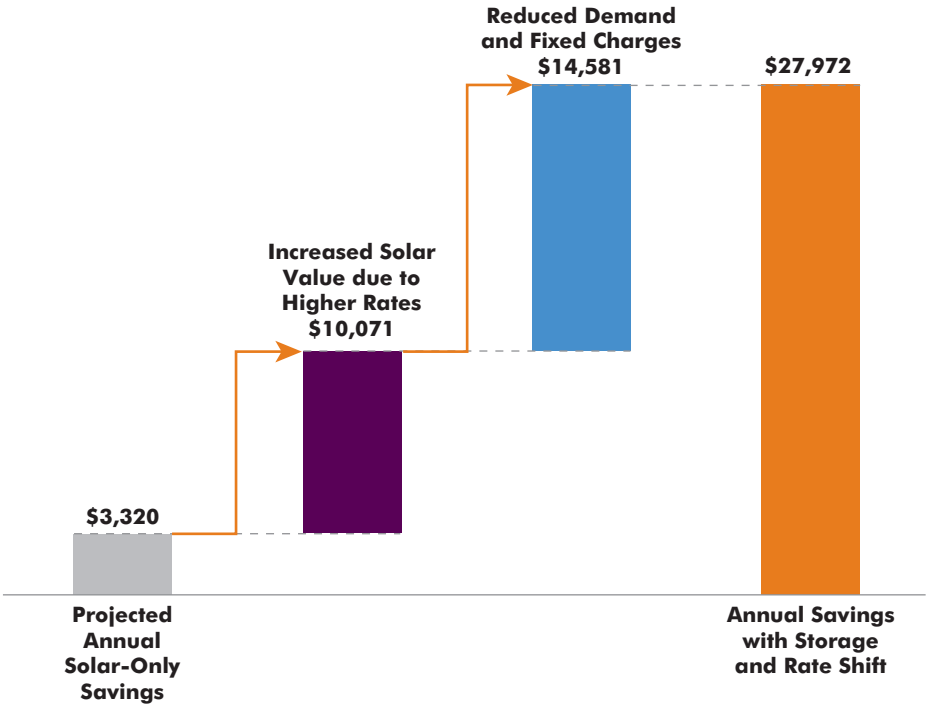
Under certain circumstances, energy storage can enable a property to switch utility rate tariffs, which can unlock even greater bill savings potential. SDG&E customers with a monthly peak demand of less than 20 kilowatts can choose to be billed under the utility's TOU-A rate tariff. TOU-A has higher electricity usage prices than SDG&E's TOU-AL rate tariff, but does not have any fees for demand charges and has a lower monthly fixed charge.

The affordable housing property analyzed in this paper had a monthly peak demand ranging from 25 kilowatts to 35 kilowatts. By pairing a battery with the solar system, the property would be able to reduce monthly demand enough to keep it below SDG&E's 20-kilowatt rate threshold, allowing it to opt-in to the non-demand TOU-A rate tariff.

As shown in **Figure 5**, this rate switch not only eliminates the property's demand charges and lowers its monthly fixed utility charges, it also increases the savings potential for the solar system. By opting to be billed under SDG&E's TOU-A rate tariff, the property could save over $14,500 in annual demand and fixed charges and increase bill savings from solar by more than $10,000 per year. Along with the additional savings from solar time-shifting, the total bill savings to the property amount to nearly $28,000 every year, more than three times the savings of a solar-only system under current rate structures and more than eight times the savings of solar-only under San Diego Gas & Electric's proposed rate structures.

FIGURE 5

Switching Utility Rate Tariffs with Storage Can Provide Property Owner with Savings of $24,000 per Year over Solar Alone



Using the same 60-kilowatt/90-kilowatt-hour battery system analyzed in Figure 4 to hold the property's peak demand below 20 kilowatts would allow the affordable housing owner to switch the property to a new rate structure without demand charges, San Diego Gas & Electric's TOU-A tariff. This rate tariff has higher electricity use charges, which also increases the value of the solar system. The combined savings due to the elimination of demand charges, lower fixed charges, and increased solar value results in an annual bill savings of nearly $28,000—far more than could be achieved through solar alone.

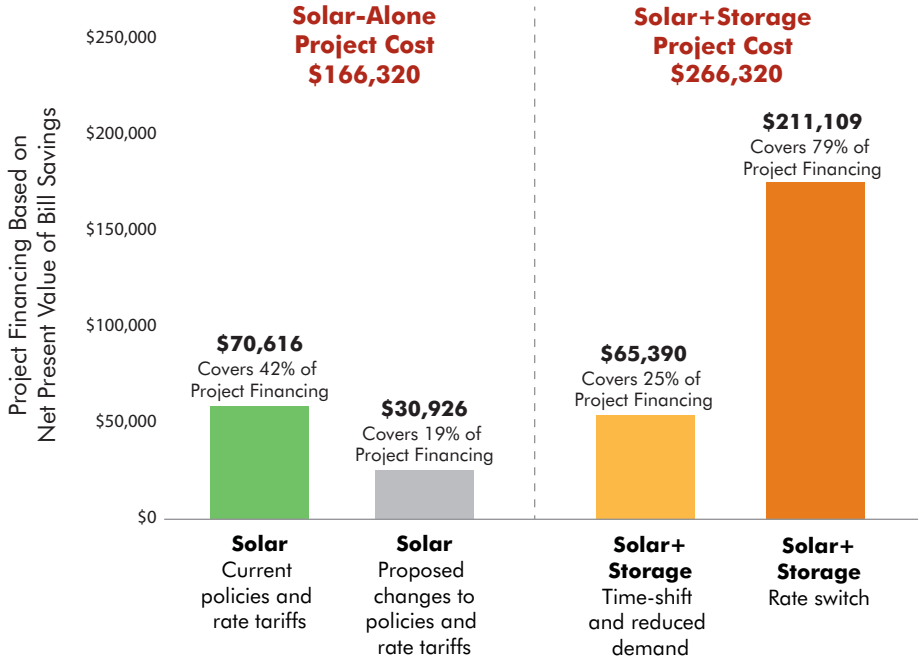
Solar Value Affects Solar Financing

THE ANTICIPATED DECLINE IN THE VALUE of solar along with the expected increases in utility costs can have a significant effect on solar project economics and financing. As illustrated in **Figure 6**, the $4,000 annual loss in solar savings resulting from SDG&E's proposed rate changes (Figure 3) would translate into a nearly $40,000 loss in project financing. That represents roughly 25 percent of the estimated installed cost of the solar system analyzed for this property. Such significant reductions to available cash flow pose immediate questions about project feasibility and whether other investment strategies should be pursued in conjunction with solar to mitigate the financial challenges to property owners under new utility rate structures.

While adding energy storage increases the overall cost of a solar system, it can also leverage additional financing by achieving greater annual bill savings. For instance, incorporating a $100,000 battery system to the solar project increases the amount of project costs that can be financed, based on the net present value of bill savings, by about

FIGURE 6

With Proposed Changes, Storage Increases the Net Present Value of Energy Saving, Leveraging Additional Project Financing



Property contributions to solar system financing are influenced by the present value of expected electricity bill savings. The negative impact of proposed rate changes on the net present value of solar bill savings would reduce the amount of project costs that could be covered from energy savings by nearly $40,000, resulting in a drop in project financing from 42 percent to 19 percent. A reduction of this magnitude could threaten the feasibility of a solar project. Introducing storage increases the total project cost, but also increases annual energy bill savings. In the case of a storage system used for shifting to a non-demand utility rate tariff, the project financing available based on the net present value of these savings would amount to more than $210,000, equating to 79 percent project cost coverage. Project costs assume an installed cost of $3.20 per watt for solar and $1.67 per watt for storage.

© Art Gray Photography

$35,000 over solar-alone under SDG&E's new TOU structure and proposed demand charge rates (Figure 4).[18] That amounts to an increase in total project cost coverage from 19 percent for solar-alone to 25 percent for a combined solar and storage system. Nonetheless, while the improvement to cash flow and capital cost coverage is a positive net benefit to project economics, it is likely that additional property resources would be needed to cover the additional costs of adding energy storage.

The impact of storage on project financing is even more striking for properties where rate switching is a possibility. For the property analyzed, storage savings through rate switching unlock more than $180,000 in additional project financing (Figure 5). In this case, the net present value of annual system bill savings could be leveraged to cover approximately 79 percent of the total project cost, triple the cost coverage of solar-alone under SDG&E's current utility rate structure.

In terms of simple payback, a solar-only project for this property, with a total cost of $166,320 and annual savings of $7,581, would have about a seven-year payback today, assuming the property can take advantage of federal tax incentives and depreciation.[19] Under proposed net metering and SDG&E rate changes, the simple payback would jump to more than 20 years, making the project a poor economic prospect. Despite the additional capital costs, adding storage to the solar system would drop the simple payback back down to about nine years under the demand reduction and time-shifting scenario. Under the storage rate-switching scenario, the project could achieve an impressive simple payback of four years.

Factoring in additional value streams available to affordable housing, such as solar and storage incentives, it is reasonable to conclude that storage could have an important role in making project economics pencil out without the need for complex financing schemes. As energy storage costs decline, these benefits will be further enhanced.

While adding energy storage increases the overall cost of a solar system, it can also leverage additional financing by achieving greater annual bill savings.

Low-Income Tenants Face Additional Economic Challenges

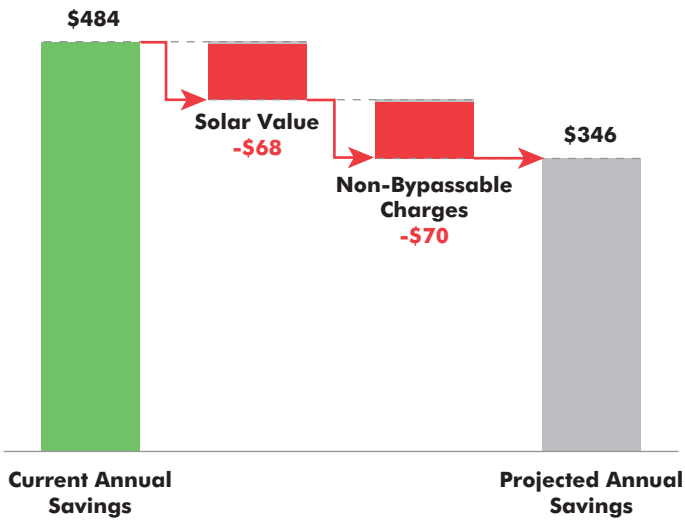
LOW-INCOME HOUSEHOLDS RESIDING IN multifamily affordable housing face many of the same negative impacts on the value of solar as property owners, as well as additional challenges that reduce the overall level of benefits that they can receive from solar installations. These reductions to benefits should be of particular interest to California policymakers because of legislative mandates that low-income tenants participating in the state's Multifamily Affordable Housing Solar Roofs program receive direct economic benefit from qualifying solar energy systems.

To explore the potential impact on benefit levels received by tenants, the analysis assessed changes to the value of solar under current and new TOU pricing periods for low-income households billed under SDG&E's DR-TOU California Alternative Rate for Energy (CARE) rate tariff.[20] The analysis found that changing TOU periods would reduce current tenant benefit levels by 14 percent and that non-bypassable charges applied to CARE beneficiaries would further reduce the value of solar by another 14 percent. These declines, illustrated in **Figure 7**, reduce the value that an average two-bedroom, low-income household would receive from solar by nearly $140 per year.

From this reduced value of solar baseline, low-income tenants may also be subject to additional reductions to the economic benefits of solar that result from the system's utility bill savings. These additional benefit reductions include potential rent increases that could result from utility allowance adjustments and reductions to the level of monetary benefits received by the tenant under CARE, which ironically occur as a result of solar generation offsetting electricity costs. When the impacts from solar devaluation, rent increases, and CARE benefit adjustments are fully considered, a PV system could actually provide less overall monetary benefits to a low-income household than if the affordable housing tenant had remained on CARE without a solar system.

FIGURE 7

Proposed Changes Reduce Tenant Annual Savings from Solar by $138, a 29% Loss



The combined impact of shifting time-of-use pricing periods and non-bypassable charges would reduce the value of a residential solar system in San Diego by 29 percent. The annual saving shown in this figure represent a two-bedroom rental unit served by a 2.5-kilowatt PV system producing 3,608 kilowatt-hours per year for an affordable housing tenant billed under the San Diego Gas & Electric CARE TOU rate tariff.

Addressing and resolving the potential economic benefit deficits affecting low-income tenants will require a broader menu of investment options and policies. These issues should be a high priority to policymakers as delivering economic benefits directly to tenants is an essential component of California's new multifamily affordable housing solar incentive program.

While the analysis of tenant benefits did find that energy storage could provide enough added value to low-income households to reverse solar value reductions, the net gain to low-income households would be small—only about $14 per year for a two-bedroom household. This is primarily

When the impacts from solar devaluation, rent increases, and CARE benefit adjustments are fully considered, a PV system could actually provide less overall monetary benefits to a low-income household than if the affordable housing tenant had remained on CARE without a solar system.

because residential customers do not currently face demand charges, so the only bill savings available through storage is due to time-shifting solar energy from off-peak to peak pricing periods. The added value of time-shifting alone may not be enough to justify the additional expense of storage at today's system prices. However, additional value streams, such as demand response programs and providing grid services, could make storage a viable option for low-income residential solar customers. Policy considerations for incentivizing solar energy system deployment in multifamily affordable housing can also be implemented to ensure that a portion of the property's energy storage bill savings are directly shared with tenants.[21]

Conclusion: Preparing for Solar Risk

THE ANALYSIS PRESENTED IN THIS PAPER was developed to assess the impact of changes to net metering and utility rates on both property owners and tenants of multifamily affordable housing. These changing solar economics present very real risks for California's affordable housing sector. As discussed, TOU peak pricing shifts and new utility rate structures, while at times adversely affecting the value proposition of stand-alone solar investments, may open new integrated energy investment opportunities to address that challenge.

By adopting integrated solar and storage solutions, multifamily affordable housing properties and other solar customers could make investments that are more financially sustainable over time, and that can adjust and adapt to changing grid dynamics. This is both beneficial for the grid and a vitally important outcome to the cash-strapped affordable housing sector, which is particularly sensitive to financial uncertainty and rising energy expenses.

These findings also have important implications for the design of incentive programs aimed at advancing solar deployment in California's low-income communities. At a minimum, it is recommended that:

- A broader survey of the impacts of proposed solar policy and utility rate changes on the economics of solar for the affordable housing sector should be conducted in California.
- Barriers to the greater deployment of integrated clean energy solutions for affordable housing, specifically solar combined with energy storage, must be identified and addressed.
- Incentives for the development of flexible, integrated solutions, like energy storage, should be considered in the design and implementation of any programs with the goal of encouraging the development of solar energy systems in affordable housing, such as California's Multifamily Affordable Housing Solar Roofs Program.

By adopting integrated solar and storage solutions, multifamily affordable housing properties and other solar customers could make investments that are more financially sustainable over time, and that can adjust and adapt to changing grid dynamics.

California is at the forefront of solar adoption in the United States and is a harbinger of changes that could impact the solar landscape across the country. Indeed, many other states are already exploring solar policy reform and new business models for utilities in the face of declining revenues. In 2016 alone, more than half of U.S. states reevaluated or adjusted net metering policies.[22] Among compromises reached by utilities and solar advocates on the future of state net metering policies, there has been a growing trend towards TOU rate structures and introducing and increasing demand charges, even for residential customers.

These types of energy market transitions reset the pricing signals for directing distributed, clean energy investment decisions. They can challenge the current solar business models, but they also open new opportunities to facilitate the deployment of more integrated energy investments that support a smarter and more flexible electric power system. As solar adoption continues to expand and more of these market trends emerge, it will become clear that the path forward for solar is increasingly tied to energy storage.

ENDNOTES

1 The intent of this paper is to illustrate the impact of changes to net metering policies and utility rates structures, not to explore the underlying reasons behind these shifts. The reevaluation of existing net metering policies and adjustments to utility business models are an inevitable result of the success of solar in a region. These topics are beyond the scope of this paper and will be explored in more detail in subsequent publications.

2 California Public Utilities Commission, "Decision Adopting Successor to Net Energy Metering Tariff," January 28, 2016. Available online at *http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M158/K181/158181678.pdf.*

3 California Public Utilities Commission, "Decision Adopting Policy Guidelines to Assess Time Periods for Future Time-of-Use Rates and Energy Resource Contract Payments," December 15, 2016. Available online at *http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M171/K250/171250399.pdf*.

4 Sage Renewable Energy Consulting, "Changes to Time of Use (TOU) Periods Threaten Value of Commercial Solar in California," January 10, 2016. Available online at *http://www.sagerenew.com/press/utility-tariff-tou-changes-threaten-solar.*

5 The analysis reviewed selected utility tariffs submitted in SDG&E's GRC for commercial multifamily buildings and low-income residential units. For commercial buildings, utility schedules TOU-A and TOU-AL were reviewed. For low-income residential units, the DR-TOU CARE rate was reviewed. The analysis utilized electricity consumption load profiles for commercial and residential units to model electricity usage over a 12-month period. Solar generation profile data from CAISO was used to model solar generation. Property demand profile based on actual 15-minute interval usage data for a 50-unit individually metered multifamily affordable housing property located in southern California. Electricity consumption and demand at multifamily properties and in tenant units can vary based on many factors. As such, while the profiles selected are reasonable representations of conditions found at multifamily properties, the results are only illustrative of the assumed conditions.

6 San Diego Gas & Electric, "2016 GRC Phase 2," February, 9 2016. Available online at *http://www.sdge.com/sdge-2016-GRC-Phase-2.*

7 Clean Energy Group, California Housing Partnership, Center for Sustainable Energy, and Geli, "Closing the California Clean Energy Divide: Reducing Electric Bills in Affordable Multifamily Rental Housing with Solar+Storage," May, 2016. Available online at *http://www.cleanegroup.org/ceg-resources/resource/closing-the-california-clean-energy-divide*

8 California Assembly Bill No. 693, "AB-693 Multifamily Affordable Housing Solar Roofs Program," October, 8 2015. Available online at *https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB693*

9 Greentech Media, "With Net Metering Secure, California Now Faces Uncertainty from Time of Use Changes," February 16, 2017. Available online at *https://www.greentechmedia.com/articles/read/with-net-metering-secure-california-solar-now-faces-threat-from-time-of-use.*

10 Daily solar generation profile based on an average of California Solar Initiative data for SDG&E during the month of August. Available online at *https://www.californiasolarstatistics.ca.gov/data_downloads.*

11 In the analysis, an effective energy price was calculated to estimate the weighted cost of electricity based on the property and tenant electricity consumption profiles. Solar valuation was calculated based on the amount of generation, time of generation, and utility value applicable at the time of generation. The results of the analysis reflect changes to the value of solar generation under the two different TOU rate structures.

12 This decline is based on properties billed under SDG&E's current TOU-AL rate tariff. The decline in solar value is relatively small compared to other rate structures because of narrower differences between peak and off-peak pricing under TOU-AL. TOU-AL is the standard commercial rate tariff for SDG&E customers with a peak demand of 20 kilowatts or greater. Available online at *http://regarchive.sdge.com/tm2/pdf/ELEC_ELEC-SCHEDS_AL-TOU.pdf.*

13 Estimated bill savings referenced in this paper represent annual savings over the first year of system operation.

14 The estimate of future increases to demand changes under the TOU-AL schedule in our analysis reflect the differences between current demand changes and fixed fees and year 3 proposed demand changes and fixed fees as referenced in "SDG&E, A.15-04-012: Illustrative Rates Exhibit, Revenue Allocation Settlement Agreement, Attachment F—Proposed Rates for Year 3 Proposed Rates Settlement," pages 23–24, November 29, 2016. Available online at *http://www.sdge.com/sdge-2016-GRC-Phase-2.*

15 Navigant Consulting prepared for Green Charge, "The Benefits of Solar Plus Storage for Commercial and Public Buildings," 2016. Available online at *http://www.greencharge.net/the-benefits-of-solar-plus-storage-for-commercial-and-public-buildings/*

16 For demand reduction and solar time-shifting calculations, the energy storage system was sized to provide a 35 percent reduction in peak electricity demand and to collect 35 percent of the PV generation during off-peak electricity pricing periods to be discharged during peak periods. These sizing parameters are within the norm of systems being deployed to serve smaller commercial buildings such as multifamily housing.

17 San Diego Gas & Electric, "Schedule TOU-A" Available online at *http://regarchive.sdge.com/tm2/pdf/ELEC_ELEC-SCHEDS_TOU-A.pdf.*

18 Net present value is a measure of the amount invested in the project compared to estimated future savings after they are discounted by a specified rate of return, in this case 4 percent. Project cost coverage assumes a debt coverage ratio of 1.2 and an interest rate of 6.5 percent. Solar savings assume a 20-year system lifetime. Energy storage savings assume a 10-year system lifetime.

19 Simple payback calculations do not account for additional system operation and maintenance expenses, nor do they consider utility cost increases beyond those proposed in SDG&E's current GRC.

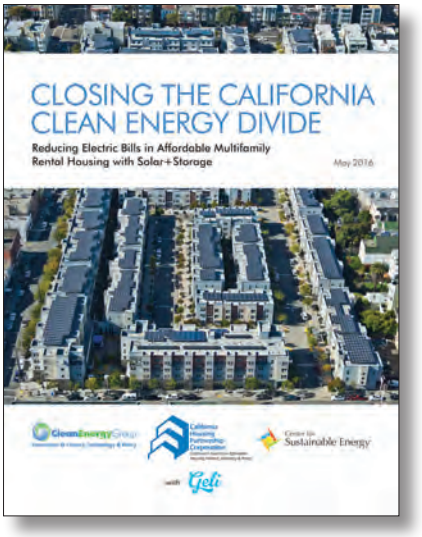
20 The estimate of residential solar valuations for multifamily tenants relies on SDG&E's proposed TOU Domestic Residential CARE rates as referenced in "SDG&E, A.15-04-012: Illustrative Rates Exhibit, Revenue Allocation Settlement Agreement, Attachment B - Proposed Rates for Year 1 Proposed Rates Settlement," page 9, November 29, 2016. Available online at *https://www.sdge.com/sites/default/files/regulatory/Illustrative%20Rates%20%e2%80%93%20Revenue%20Allocation%20Settlement.pdf*

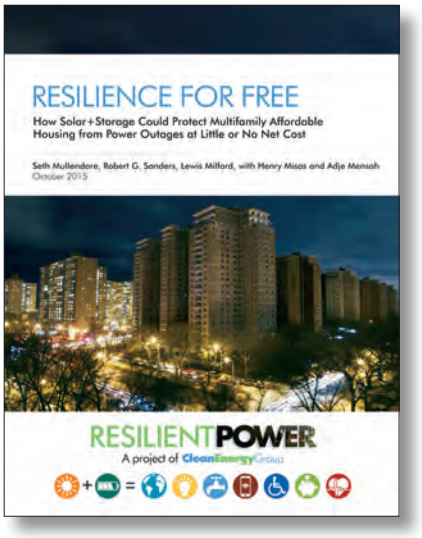
21 There are several ways to ensure that tenants directly share in property energy storage bill savings. For some properties, a greater portion of solar in the integrated solar energy system could be allocated to directly offset tenant electricity consumption than would be feasible without storage, which is particularly important for multi-story buildings and those located in dense urban areas. Properties could also choose to adopt a shared savings model, under which tenants are directly allocated a portion of the property bill savings.

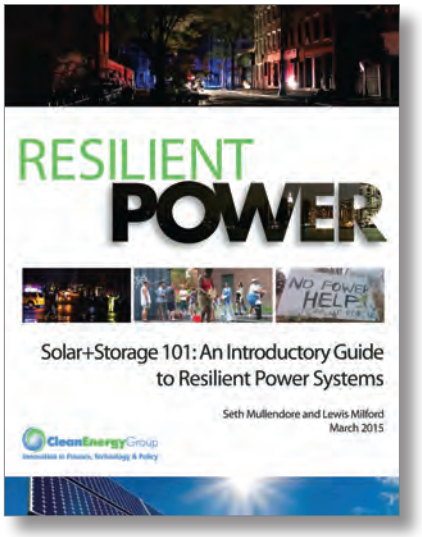
22 North Carolina Clean Energy Technology Center, "The 50 States of Solar Report: 2016 Annual Review and Q4 Update," January 31.2017. Available online at *https://nccleantech.ncsu.edu/the-50-states-of-solar-report-2016-annual-review-and-q4-update.*

OTHER RESILIENT POWER PROJECT RESOURCES

Clean Energy Group and the Resilient Power Project have produced reports and analysis on a wide range of resilient power policy, finance, and technology application issues. Please see a sample of those reports below. For a complete list of the Resilient Power Project's other informational resources, please visit *www.resilient-power.org* to access its extensive knowledge base, including webinars, blogs, and presentations.







Closing the California Clean Energy Divide: Reducing Electric Bills in Affordable Multifamily Rental Housing with Solar+Storage, by Clean Energy Group, California Housing Partnership, Center for Sustainable Energy, with Geli. Battery storage systems not only provide economic returns today, they can also preserve the value of solar in an evolving policy and regulatory environment. Because batteries empower owners of solar photovoltaics (PV) systems to take control of the energy they produce and when they consume it, storage can deliver deeper cost reductions that can be shared among affordable housing owners, developers, and tenants. This report examines the utility bill impacts of adding battery storage to stand-alone solar in affordable rental housing facilities in California's three investor-owned utility service territories, each with different rate structures. It is the first such report on these technologies in this sector in California. May 2016.

Resilience for Free: How Solar+Storage Could Protect Multi-family Affordable Housing from Power Outages at Little or No Net Cost, by Lew Milford, Robert Sanders, Seth Mullendore, Clean Energy Group. This report uses project data for buildings in New York, Chicago, and Washington, D.C. to examine the financial case for installing solar+storage systems to support critical common area loads in multifamily affordable housing. The report concludes that with the right market structures and incentives, solar+storage systems can provide a positive economic return on par with energy efficiency or stand-alone solar. In some cases, the addition of batteries improves affordable housing project economics by generating significant electric bill savings through reducing utility demand charges and creating revenue by providing grid services. October 2015.

Solar+Storage 101: An Introductory Guide to Resilient Solar Power Systems, by Seth Mullendore and Lewis Milford, Clean Energy Group. This guide provides a basic technical background and understanding of solar+storage systems. It is meant as a starting point for project developers, building owners, facility managers, and state and municipal planners to become familiar with solar+storage technologies, how they work, and what's involved in getting a new project off the ground. March 2015.

Financing for Clean, Resilient Power Solutions, by Robert G. Sanders, Clean Energy Group. This paper describes a broad range of financing mechanisms that are either just beginning to be used or that have a strong potential for providing low-cost, long-term financing for solar with energy storage. The goal is to identify financing tools that can be used to implement projects and that will attract private capital on highly favorable terms, thereby reducing the cost of solar and resilient power installations. October 2014.

ABOUT THE RESILIENT POWER PROJECT

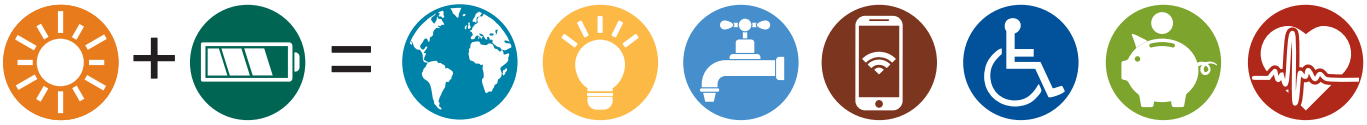
The Resilient Power Project, a joint initiative of Clean Energy Group and Meridian Institute, is working to accelerate market development of solar PV plus battery storage (solar+storage) technologies for resilient power applications serving low-income communities. The Resilient Power Project works to provide new technology solutions in affordable housing and critical community facilities to address key climate and resiliency challenges facing the country:

- **Community Resiliency** — Solar+storage can provide revenue streams and reduce electricity bills, enhancing community resiliency through economic benefits and powering potentially life-saving support systems during disasters and power outages.
- **Climate Adaptation** — Solar+storage systems can provide highly reliable power resiliency as a form of climate adaptation in severe weather, allowing residents to shelter in place during power disruptions.
- **Climate Mitigation** — Battery storage is an enabling technology and emerging market driver to increase adoption of solar PV for distributed, clean energy generation and to advance climate mitigation efforts.

The Resilient Power Project is supported by The JPB Foundation, Surdna Foundation, The Kresge Foundation, Nathan Cummings Foundation, and the Barr Foundation.

Learn more about the Resilient Power Project at
www.resilient-power.org.

RESILIENT POWER
A project of Clean Energy Group and Meridian Institute



RESILIENT POWER | PROTECTING COMMUNITIES IN NEED

CleanEnergyGroup
Innovation in Finance, Technology & Policy

50 State Street, Suite 1, Montpelier, VT 05602
Phone 802.223.2554 • Fax 802.223.4967 • info@cleanegroup.org • www.cleanegroup.org