Guidance on Utility Options to Support Commercial Solar and Solar+Storage Deployment in Underserved Communities

Erifili Draklellis, Rachel Gold, and Roberto Zanchi

RMI

NREL Technical Monitor: Sara Farrar

NREL is a national laboratory of the U.S. Department of Energy
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15013 Denver West Parkway
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Collaborating with Utilities to Meet Underserved Community Needs

A Guide to Equitable Commercial Solar and Solar + Storage Deployment

November 2023

Authors & Acknowledgments

Authors

Erifili Draklellis
Rachel Gold
Roberto Zanchi

Authors listed alphabetically. All authors are from RMI unless otherwise noted.

Contacts

Erifili Draklellis (edraklellis@rmi.org), Rachel Gold (rgold@rmi.org)

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About RMI

RMI is an independent nonprofit, founded in 1982 as Rocky Mountain Institute, that transforms global energy systems through market- driven solutions to align with a 1.5°C future and secure a clean, prosperous, zero-carbon future for all. We work in the world's most critical geographies and engage businesses, policymakers, communities, and NGOs to identify and scale energy system interventions that will cut greenhouse gas emissions at least 50 percent by 2030. RMI has offices in Basalt and Boulder, Colorado; New York City; Oakland, California; Washington, D.C.; and Beijing.

About SEIN

SEIN seeks to overcome barriers to solar adoption by connecting teams of stakeholders that are pioneering new ideas with the resources they need to succeed. Teams that participate in SEIN receive direct funding and analytical support from US Department of Energy national laboratories and participate in peer-to-peer learning with other teams tackling similar challenges.

These teams are developing and documenting their solutions for solar adoption with scale in mind, so that others can adapt those solutions to their own contexts. Ultimately, the true impact of these teams' efforts will be to enable a wide array of communities to adopt solar solutions that meet their needs in their contexts.

SEIN is funded by the US Department of Energy Solar Energy Technologies Office and is led by the National Renewable Energy Laboratory (NREL).

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Executive Summary

Introduction
Underserved communities, particularly neighborhoods of Black, Indigenous, and People of Color (BIPOC) and low- and moderate-income (LMI) households, grapple with heightened energy challenges including rising costs, power outages, and barriers to access energy efficiency services. These issues may be aggravated by significant energy burdens, evidenced by a large portion of income devoted to energy costs and extended recovery times post electrical grid disruptions.

As part of a holistic strategy to address the energy inequities faced by these communities, this report offers community organizations a tool for accessing clean energy programs, namely commercial-scale solar and solar-plus-storage (solar + storage) programs. The report:

1. Provides an overview of the potential types of programs utilities may offer to help meet community needs,
2. Offers practical guidance for effective collaboration between community organizations and utilities, and
3. Aims to facilitate the enhancement of utility programs through community input and feedback.

To that end, this report also includes a section designed to help utilities prepare for collaborations with community organizations and historically underserved communities. Inspiration is drawn from the work of three rounds of Solar Energy Innovation Network (SEIN) project teams,[1] who have championed new approaches for the adoption of solar and solar + storage solutions to tackle the energy issues that underserved communities face.

Use Cases for Commercial Solar and Solar + Storage
This report focuses on strategies for deploying commercial-scale solar, solar + storage, and solar + storage microgrid solutions for a few reasons.[i] Such installations can provide essential services to the community, thereby enhancing their impact beyond immediate benefits for the building owners and distributing those benefits to building occupants (i.e., renters) and, in some cases, the surrounding community. The allocation of these benefits is critical in addressing historically underserved community needs, such as access to clean energy resources and economic incentives for clean energy projects. Additionally, the combination of solar + storage can provide resilience benefits.

Specifically, we explore four use cases of solar and solar + storage to benefit historically underserved communities:

1. **Solar for Bill Savings**: This use case focuses on the potential financial benefits for building owners who adopt solar photovoltaic (PV) energy solutions aiming to reduce long-term operational energy costs.
2. **Solar + Storage for Bill Savings**: This scenario combines battery energy storage systems with solar systems to provide further opportunities for cost savings, depending on the

[i] Commercial-scale solar, for the purposes of this paper, refers to solar photovoltaics (PV) installed on commercial buildings (as opposed to residential buildings) such as offices, warehouses, hospitals, hotels, retail stores, schools, nonprofits, and higher-education facilities.

electricity rate. Building owners can use stored energy during peak demand times or sell it back to the utility, contingent on state policies and utility rules.

3. **Solar + Storage Microgrid for Outage Survivability**: This use case integrates energy storage with solar, designed to operate during times of outages. It is especially valuable for communities prone to outages or severe weather events, offering continuity of essential services such as emergency lighting and refrigeration.
4. **Solar + Storage Microgrid for Community Resilience**: Under this use case, public facilities such as community centers and schools are transformed into “resilience hubs” using solar + storage systems. These hubs offer shelter and essential community services during emergencies and power outages, enhancing community safety and resilience.

This report presents a strategy for communities to leverage and, in certain instances, contribute to the design of solar and solar + storage programs to better serve their specific needs. The primary goal of this report is to equip community organizations and leaders with effective strategies to harness the benefits offered by utility commercial solar and solar + storage programs. By doing so, we aim to empower underserved communities by increasing their awareness of these programs and supporting their capacity for leadership and realizing benefits. However, we recognize the responsibility of decision makers with resources and governing power to address the historic inequities these underserved communities face.

In brief, the role of these stakeholders in advancing these solutions are as follows:

- **Communities and Community-Based Organizations**: Communities play a pivotal role in promoting solar adoption, advocating for supportive policies, and fostering collaboration among stakeholders. They also contribute to community preparedness and identifying suitable locations for resilience hubs.
- **Utilities**: Utilities are responsible for managing system interconnection, offering financial incentives, providing technical support, and assisting with system design and installation. They ensure grid integration and effective energy distribution.
- **Building Owners**: Building owners secure financing for installations, manage system maintenance, and optimize bill savings. They play a vital role in system upkeep and emergency planning, particularly for resilience hubs.
- **Local Government**: Local governments act as intermediaries between stakeholders, identifying resilience hub locations and facilitating effective communication. They can ensure seamless grid integration, interconnection, and overall community resilience planning.

Guidelines for Community-Utility Collaboration

Collaboration between underserved communities and electric utilities is vital to realize the benefits of commercial solar and solar + storage solutions. Such collaboration may provide a means of starting to directly address historical and ongoing injustices within the energy system and lead toward an equitable energy future. This report identifies some successful approaches and practical guidance for collaboration, grounded in SEIN team experiences, so that communities can leverage their utilities’ commercial solar + storage programs to create benefits in the ways they prioritize. For example:

- **Community-based organizations (CBOs)** can proactively explore existing utility programs, conduct comprehensive community energy needs assessments, and analyze gaps to prepare for constructive dialogues with utilities. This report provides strategies to support CBOs in crafting questions for the utility that surface challenges and opportunities for commercial solar technology access.

- **Electric utilities** can initiate engagement by actively listening to community lived experiences and concerns. They can review and evaluate their existing programs to ensure alignment with community needs, track program uptake in underserved areas, and actively involve community stakeholders in the program planning and evaluation process. To overcome potential barriers, utilities can collaborate with community organizations, promote transparent communication, and consider proposing regulatory changes that support equitable program design. When existing programs fall short, utilities can explore the option to co-create new programs with community input, aiming to address specific community needs and priorities through shared leadership and decision-making processes.

We offer a framework for these collaborations to lead to (1) better communication about existing programs to reach underserved communities, (2) improvements to existing programs to meet community needs, and, in some cases, (3) co-creation of new utility programs to meet community needs.

Introduction

Underserved communities face significant energy challenges, especially in Black, Indigenous, and People of Color (BIPOC) and low- and moderate-income (LMI) communities.[ii] Rising costs, frequent power outages, and inequitable access to energy efficiency services are just some of the issues they face.[2] Low-income households face an energy burden three times higher than their non-low-income counterparts and over a quarter of US households experience a significant energy burden, indicative of a substantial portion of income spent on energy costs.[3] And in many of the most recent, severe outages across the country, BIPOC and low-income neighborhoods suffered the longest and most frequent outages.[iii, 4] These challenges are exacerbated by underserved communities' limited capacity to absorb financial shocks and longer delays in electric system outage restoration.[iv, 5]

While decision makers with resources and governing power bear the responsibility for addressing the injustices these underserved communities face and deploying/financing these programs, this report can be a resource to help community-based organizations (CBOs) navigate the complexities of delivering the benefits of commercial solar and solar + storage programs to their communities to harness the potential benefits of solar, such as affordability, outage survivability, workforce development, and local empowerment.[v]

CBOs are invited to review the SEIN success stories, consider potential relevance to their own community's context, and explore if these potential options could be a useful part of a holistic strategy to meet the energy needs of a community. Specific ideas on when and how to engage with the underserved community's utility are also presented for consideration. This report aims to share

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[ii] "Underserved communities" refers to populations or areas that have historically had less access to resources and services, such as quality healthcare, education, and clean energy technologies. This can include low-income communities, communities of color, rural areas, and other underrecognized groups. These communities often face higher energy burdens, meaning they spend a larger proportion of their income on energy. They may also face additional barriers to accessing clean energy, such as lack of information, up-front costs, or housing status.
[iii] The *New York Times* underscores the repercussions of the 2022 Texas blackouts on underserved communities, emphasizing that marginalized communities experienced early power outages, and historical trends suggest that these communities may face prolonged reconnection times. This situation is particularly precarious, as low-income households often lack the means to seek refuge or recover from such disruptions. Additionally, the Environmental Defense Fund demonstrates the effect of aging infrastructure and lack of investment on low-income neighborhoods and communities of color.
[iv] Research from the National Renewable Energy Laboratory (NREL) provides a framework for modeling resilience metrics, which can help illustrate the impact of power outages in different communities. This framework includes factors such as the number of hours customers are without power, the number of critical facilities without power, and the loss of business, community economic revenue, and utility revenue. Although the research does not explicitly connect higher value of lost load to underserved communities, it does highlight the importance of understanding the nuances of power system vulnerabilities and how to finance resilience solutions. The inference can be made that communities with lower levels of economic resilience may experience higher costs during power outages due to factors such as lost wages, inability to access needed services, and additional expenses related to the outage.
[v] The Urban Sustainability Directors Network defines community resilience as "the ability of people and their communities to anticipate, accommodate and positively adapt to or thrive amidst changing climate conditions and hazard events. Resilient communities enjoy a high quality of life, reliable systems, and economic vitality, and they conserve resources for present and future generations." For the purposes of this paper, "resilience" refers to a community's ability to support life-sustaining power and services during times of power outages.

the innovative approaches of SEIN teams with communities and community-based organizations to support a more equitable, clean energy system.

Federal legislation like the Inflation Reduction Act (IRA) offers strong opportunities for electric utilities to directly support and partner with under-resourced communities to drive and scale meaningful change.[vi]

[vi] Under the provisions of the Inflation Reduction Act (IRA), utilities can tap into the new funding sources to support new infrastructure in underserved communities. The Investment Tax Credit and Production Tax Credit include requirements for higher wages and job training programs, along with additional credit amounts (or "adders") for meeting specific criteria like siting clean energy in "energy communities" and investing in the domestic supply chain ("called domestic content"). For more information about these tax credits, refer to *Appendix C: Available Federal Financing Opportunities*. Utilities can also apply for the IRA's Energy Infrastructure Reinvestment program, which requires Community Benefits Plans, enabling underserved communities to benefit from new energy infrastructure.

Navigating This Report

Exploring Solar and Solar + Storage: Use Cases and Stakeholder Roles
This section introduces four distinct use cases for solar and solar + storage applications, underscoring their diverse benefits and challenges. It delves into the roles and responsibilities of key stakeholders — communities, utilities, and building owners — for each use case. The use cases covered include:

1. Solar for Bill Savings
2. Solar + Storage for Bill Savings
3. Solar + Storage Microgrid for Outage Survivability
4. Solar + Storage Microgrid for Community Resilience

Guidelines for Effective Collaboration between Utilities and Community-Based Organizations: Meeting Your Community's Needs through Collaboration
Practical guidelines are described for community-based organizations and utilities to effectively build collaborative relationships. It outlines the key considerations and strategies for successful collaboration in the pursuit of solar and solar + storage projects.

Appendix A: Benefits and Challenges of Solar and Solar + Storage
This appendix provides a deeper dive into the potential benefits and challenges associated with the adoption of solar and solar + storage systems (including those with microgrids) for communities, utilities, and building owners. It highlights considerations and trade-offs that can guide decision-making and strategies to maximize the benefits and mitigate the challenges.

Appendix B: Supportive Utility Offerings
This appendix discusses the various forms of technical and financial support that utilities can offer to facilitate the deployment of solar and solar + storage systems. It includes insights into rate structures, incentive programs, grants, loans, and other supportive offerings that can help drive solar and solar + storage adoption.

Appendix C: Available Federal Financing Opportunities
This appendix highlights select federal financing opportunities through the Inflation Reduction Act, notably the updated Investment Tax Credit.

Appendix D: Non-Technical Glossary
This glossary explains non-technical terms and acronyms used in the report, helping readers understand the community and economic topics discussed.

Appendix E: Technical Glossary
This glossary defines technical terms used throughout the report, assisting readers in understanding the technical details of solar, solar + storage, and microgrid applications discussed.

Exploring Solar and Solar + Storage: Use Cases and Stakeholder Roles

Commercial-scale solar and solar + storage systems can present one opportunity to improve energy-equity in BIPOC, LMI, and other under-resourced communities, as part of a comprehensive approach to energy equity.

Recognizing this potential, SEIN teams and their communities are exploring ways to harness solar power to support:

- Affordability, in the form of electricity bill savings
- Power outage survivability
- Resilience
- Health and environmental justice
- Job creation and workforce development
- Local empowerment

Communities, utilities, and building owners can work together to deploy solar and solar + storage systems to meet specific community needs, primarily affordability in the form of energy bill savings, power outage survivability, and resilience. Four tangible use cases are explored below: 1. Solar for Bill Savings, 2. Solar + Storage for Bill Savings, 3. Solar + Storage for Outage Survivability, and 4. Solar + Storage for Community Resilience.[vii] SEIN Round 3 identified other community needs, such as aspirations for community ownership and broader economic development, that are not addressed.

For each use case, we detail the primary steps involved. In the section *The Role of Communities, Community-Based Organizations, Utilities, and Building Owners* we then detail the unique roles of communities, utilities, and building owners in the four use cases.[viii]

Four Use Cases for Solar and Solar + Storage

The four use cases below offer different perspectives on the potential application of commercial solar and solar + storage systems.

1. Solar for Bill Savings
2. Solar + Storage for Bill Savings
3. Solar + Storage Microgrid for Outage Survivability

[vii] Other strategies can contribute to reducing energy costs, including energy efficiency measures, such as upgrading to energy-efficient appliances, improving insulation, and optimizing energy management systems. Additionally, demand response programs, where utilities incentivize customers to reduce their energy use during peak demand periods, can also provide savings. The best approach will depend on the specific assessment of each building, return on investments, and meeting community objectives.

[viii] Developers play a consistent and crucial role across all four use cases, working closely with building owners and utilities to design, install, and maintain solar and solar + storage systems. They assist with regulatory compliance, financing arrangements, and community engagement, among other tasks. However, to avoid repetition and maintain focus on the unique aspects of each use case, this chapter does not delve into the specifics of developers' roles in each scenario.

4. Solar + Storage Microgrid for Community Resilience

The first two use cases are centered around bill savings for the building owners. These bill savings can support small business owners from under-resourced communities. The third and fourth use cases emphasize outage survivability and community resilience, which offer more direct benefits to the community at large, including continuity of essential services during power outages and the establishment of community resilience hubs that can serve as emergency shelters and support the community in times of disaster.

Communities have an opportunity to take the lead — by promoting the adoption of solar power, identifying supportive policies, and actively participating in planning and operations. The application of a particular use case to another community is context-sensitive, influenced by the specific needs of the community, the nature of stakeholder partnerships, and the resources available. CBOs play a specialized role in leading local initiatives and fostering partnerships and can ensure that specific community needs in renewable energy projects are addressed.

Building owners themselves can be considered part of the community, especially when their properties are within the defined geographic area or are themselves members of that community. In many examples throughout the work of the SEIN teams, building owners are active members of the community, contributing to its well-being and participating in local initiatives.

Utilities can support and facilitate the implementation of renewable energy projects to support energy equity, but the actual extent of their involvement may vary based on state regulations, utility business models, and their history with the relevant community. The utilities detailed in this report had the ability to support advancing energy equity through tailored incentives and technical support — and other utilities might have more constraints.

For a more comprehensive understanding of the benefits and challenges associated with these use cases, as well as a detailed list of supportive utility offerings, refer to *Appendix A: Benefits and Challenges of Solar and Solar + Storage* and *Appendix B: Supportive Utility Offerings*, respectively. For non-technical terms, see *Appendix D: Non-Technical Glossary*, and for technical terms, refer to *Appendix E: Technical Glossary*.

Use Case 1: Solar for Bill Savings

The Solar for Bill Savings use case outlines the potential financial benefits building owners might achieve by adopting solar energy solutions. However, the exact savings and costs associated with solar depend on the chosen financing model (e.g., outright purchase, lease, or solar power purchase agreement [PPA]), local regulations, and specific terms. This use case, which may be particularly attractive for small to mid-sized commercial buildings, offers a cost-effective solution to optimize energy consumption and reduce utility bills, largely due to the energy usage patterns and manageable installation scale characteristic of these building sizes.

While commercial solar can lead to potential energy cost savings, there may be significant up-front costs. Every financing mechanism, like third-party agreements, has its nuances, and the potential bill savings should be carefully evaluated in each specific scenario.[6] Additionally, stand-alone commercial solar doesn't automatically provide power during grid-scale outages. This is because, for safety reasons, most solar systems are designed to shut down when the main power grid goes off to protect utility workers that are fixing the grid.

Utilities play an essential role in integrating solar power into the grid and ensuring smooth operations for both the grid as a whole and individual customers. By effectively managing these solar resources, utilities can mitigate the risk of cost disparities among users. If policies and programs are designed without appropriate protections and attention to prioritizing the needs of underserved communities, these communities would be disproportionately impacted by such costs.

Utilities can also help reduce the up-front costs of solar installations through rates (e.g., on-bill financing whereby the utility pays the entire up-front cost and in return a new charge is added to the customer bill to be paid back over several years), compensation mechanisms, and financial incentives. At the same time, utilities need to manage potential challenges like revenue loss from reduced electricity sales and potential challenges associated with the integration of many customer-controlled assets into the grid.[ix]

Table 1 below provides a step-by-step breakdown of how this use case for solar works.

[ix] As more customers switch to solar power, they buy less electricity from utilities, which can lead to a reduction in the utilities' revenue. Generally, utilities recover some of their fixed costs through volumetric (e.g., $/kWh) charges. When these sales decrease more than expected, utilities may collect less than their authorized fixed costs; if not controlled through regulator mechanisms, it could create a bias toward promoting higher sales and against demand reduction resources like customer solar (that decreases sales).

Table 1: *How it Works: Solar for Bill Savings*

1	Cost Evaluation: Building owners compare the total costs of installing and maintaining a potential solar system to the costs of purchasing power from the grid. Note that the total upfront cost of solar PV must be included in the calculation.
2	Financing and Incentives: Building owners assess financial incentives and implications, including eligibility for Investment Tax Credits, local government incentives, and utility rebate programs. They also evaluate the requirements and availability of bridging loans if needed.
3	Procurement: Building owners select a suitable solar system provider by comparing offers from multiple vendors based on quality, reliability, and cost. They then engage in negotiations, finalize contracts, and set installation timelines.
4	Utility Assistance: Utilities assist with interconnection to the grid and ensuring compliance with safety and regulatory requirements.
5	Installation: Commercial building owners work with professional installers or contractors to install solar panels on their buildings.
6	Power Generation: The installed solar panels generate electricity, potentially offsetting customer load.
7	Operation: By reducing draws on the grid, the solar system may provide cost savings, the ability to manage peak demand, and contributions to grid reliability.*

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Notes on Table 1:
** These benefits are more likely to materialize in places where the ratio of total system demands to available supplies is highest during the day, as opposed to locations that are curtailing solar resources due to oversupply.*

Use Case 2: Solar + Storage for Bill Savings

The Solar + Storage for Bill Savings use case offers building owners a more advanced opportunity to save on bills by integrating energy storage with solar systems. This use case, which as Use Case 1 may be particularly attractive for small-mid commercial buildings, enables building owners to use stored energy during expensive peak demand times or sell it back to the utility; the best choice will depend on specific state policies and utility rules.[x, 7] Building owners can flexibly use or deploy the power generated in times that benefit them the most.

[x] State policies could include net energy metering (with credits at the retail rate and other detailed rules), net billing, or other policies.

Utilities can support this solar + storage use case by formulating incentive programs tailored specifically for solar and/or storage systems, including rebates, grants, or tax credits, to ease the installation process. Moreover, utilities can provide technical assistance and rate structures for integrating and balancing these complex systems on the grid. Some of the challenges utilities face lie in developing equitable rate structures and compensation mechanisms that fairly value the addition of storage and managing the increased complexity in grid integration of many customer-controlled assets when storage is included.

Table 2 provides a step-by-step breakdown of how this use case for solar + storage works.

Table 2: How it Works: Solar + Storage for Bill Savings

1	Cost Evaluation: Building owners compare the total costs of installing and maintaining a potential solar + storage system to the costs of purchasing power from the grid.
2	Financing and Incentives: Building owners assess financial incentives and implications, including eligibility for Investment Tax Credits, local government incentives, and utility rebate programs. They also evaluate the requirements and availability of bridging loans if needed.
3	Procurement: Building owners select a suitable solar + storage system provider by comparing offers from multiple vendors based on quality, reliability, and cost. They then engage in negotiations, finalize contracts, and set installation timelines.
4	Utility Assistance: Utilities assist with interconnection to the grid and ensuring compliance with safety and regulatory requirements.
5	Installation: Commercial building owners work with professional installers or contractors to install solar panels and energy storage units on their buildings.
6	Power Generation: The solar panels generate electricity that can be used immediately or stored for later use.
7	Operation: By reducing reliance on the grid, particularly at times of high prices, the solar + storage system can potentially offer cost reductions, capability to manage peak demand, and support for grid reliability.

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Definitions: “Islanding” and “Microgrid”

Islanding: The ability of an energy asset to disconnect from the main grid and continue operating independently. This can be crucial during power outages or grid instability.
Microgrid: Microgrid technology refers to a localized group of electricity sources and loads that can function independently from the traditional, centralized electrical grid (i.e., the ability to island). Microgrids can operate while connected to the main electrical grid during normal conditions but can also disconnect and operate autonomously using local energy generation in times of crisis, such as during power outages or significant price spikes. This technology enhances energy resilience and reliability, especially in cases of extreme weather events or other disruptions.

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Use Case 3: Solar + Storage Microgrid for Outage Survivability

The Solar + Storage Microgrid for Outage Survivability use case provides solar + storage with islanding capabilities to offer a limited power supply during outages,[xi] which may be particularly useful for buildings located in areas prone to outage or severe weather events.[8] Because of their size or the presence of critical loads, hospitals, universities, and industrial businesses may find this use case especially valuable for ensuring uninterrupted power supply during outages.

This use case enables buildings to continue to provide critical functional services for a limited time. We consider "critical functional services" as those that are crucial for safety and basic functionality, such as emergency lighting, heating and cooling, refrigeration for medications, and power outlets for charging phones and medical equipment.[9] These more resilient systems therefore protect building owners from disruption and may ensure continued services for the community during grid interruptions.

These microgrid systems incorporate islanding capability, which allows them to operate independently from the power grid. The energy storage is sized to sustain critical functional services for short durations, rather than to provide a comprehensive, longer-term power solution during outages. By contrast, Use Case 4 below is focused on broader community resilience, with a microgrid able to sustain and support the community for longer periods of time.

The ability to power critical functional services is contingent upon factors like the battery's charge level and prevailing weather conditions that may affect solar energy generation. Building owners may grapple with the challenges of installation and operational costs and must strike an optimal balance between cost-effectiveness and resilience.

Utilities need to ensure proper system interconnection and regulatory compliance, all while maintaining a reliable and resilient grid. As with the previous two use cases, utilities can help promote the successful deployment of these systems through offerings like financial assistance through rebates and grants or implementing innovative compensation and rate structures that encourage optimized energy usage and cost savings. Utilities can support these projects by assisting with system design, installation, and grid connections.

Table 3 provides a step-by-step breakdown of how this use case for solar + storage works.

[xi] The duration of power supply provided by the solar + storage system can vary depending on a range of factors, including the capacity of the installed storage system, the energy demands of the essential services being powered, and the duration and severity of the power outage. This use case is illustrative and actual projects should be tailored to the specific needs and conditions of each site and scenario. A detailed assessment is recommended to determine the appropriate storage capacity and duration for each specific application.

Table 3: How it Works: Solar + Storage Microgrid for Outage Survivability

1	System Design: The design process takes into consideration the specific needs of the community-serving businesses and ensures the system is adequately sized to at least maintain the business' critical operations during an outage.
2	Financing and Incentives: Building owners assess financial incentives and implications, including eligibility for Investment Tax Credits, local government incentives, and utility rebate programs. They also evaluate the requirements and availability of bridging loans if needed.
3	Procurement: Building owners select a suitable solar + storage system provider by comparing offers from multiple vendors based on quality, reliability, and cost. They then engage in negotiations, finalize contracts, and set installation timelines.
4	Utility Assistance: Utilities assist with interconnection to the grid and ensuring compliance with safety and regulatory requirements.
5	Installation: Both solar panels and energy storage units are installed and configured to work in tandem to provide backup power for critical functional services.
6	Islanding Configuration: Islanding, a feature that allows solar + storage systems to operate independently from the grid during an outage, is incorporated into these systems to give them the capability to continue functioning even when the grid is down.
7	Outage Detection and Response: The system is equipped to provide backup power to designated critical functional services instantly during an outage, however, it is limited in capacity and duration.
8	Power Provision during Outage: The solar + storage system offers limited backup power, prioritizing critical functional services like emergency lighting and refrigeration.
9	Post-Outage Reconnection: Once grid power is restored, the solar + storage system automatically resumes normal operations and begins recharging the energy storage unit.

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Use Case 4: Solar + Storage Microgrid for Community Resilience

Under the Solar + Storage Microgrid for Community Resilience use case, public facilities such as community centers and schools are converted into resilience hubs using solar + storage systems.[10] Resilience hubs provide shelter and resilience services to the broader community during emergencies and power outages, making them a source of community safety and resilience.

"Community resilience services," in this context, encompass a comprehensive suite of supports provided by resilience hubs to ensure community safety, health, and well-being during and between emergencies. This includes temporary shelter during extreme weather events, distributing necessities like food and multilingual information, and facilitating community-building efforts.[11] Moreover, these resilience hubs can offer vital amenities including emergency services, Wi-Fi for communication, and medical refrigeration to preserve medications and vaccines during power outages or disasters.[12] Resilience hubs are particularly beneficial in areas where municipal buildings, like city halls or public health facilities, play a central role in emergency preparedness and response, ensuring essential services remain accessible during crises.

Local governments typically take the lead in resiliency planning, including the identification of community services or public facilities that would serve as resilience hubs in emergencies. It's vital to confirm if local and utility resiliency plans are in place and aligned, ensuring a cohesive approach to community safety and resilience.

This use case requires collaborative effort from all stakeholders. Communities and local governments can take a leading role in selecting appropriate locations for resilience hubs and fostering community preparedness, while building owners are responsible for the maintenance of these systems and working with others to establish emergency plans.

Utilities are responsible for ensuring proper grid integration and interconnection of solar + storage systems. They can provide financial support, such as rebates and financing arrangements, to alleviate the installation costs. In addition, they may offer technical support services, guiding system design, helping navigate regulatory requirements, and aiding in resilience planning.[xii] Collaborative partnerships between utilities and local governments can enhance the effectiveness of these efforts, going above and beyond normal grid operations and interconnections to ensure that resilience hubs effectively serve their communities during emergencies.

Table 4 provides a step-by-step breakdown of how this use case for solar + storage works.

[xii] Resilience planning in this context involves the utilities' active participation in preparing the community for emergencies by identifying critical services that must remain operational during a power outage. Utilities also assist in crafting emergency response plans and devising resilience strategies, ensuring the community can effectively navigate and recover from disruptive events.

Table 4: How it Works: Solar + Storage Microgrid for Community Resilience

1	Resilience Hub Location Selection: Suitable locations for resilience hubs, such as community centers, schools, or other public facilities, are identified and prioritized within underserved communities.
2	Identification of Resilience Services: The community resilience services required during outages or disasters are identified, considering the specific needs of the community.
3	System Design: The solar + storage system is designed to sufficiently power the resilience hub and enable the selected community resilience services during emergencies.
4	Financing and Incentives: Building owners assess financial incentives and implications, including eligibility for Investment Tax Credits, local government incentives, and utility rebate programs. They also evaluate the requirements and availability of bridging loans if needed.
5	Procurement: Building owners select a suitable solar + storage system provider by comparing offers from multiple vendors based on quality, reliability, and cost. They then engage in negotiations, finalize contracts, and set installation timelines.
6	Utility Assistance: Utilities assist with interconnection to the grid and ensure compliance with safety and regulatory requirements.
7	Installation: The solar panels and energy storage units are installed at the chosen resilience hub locations. Additional essential equipment for emergency services is also installed.
8	Islanding Configuration: Islanding, a feature that allows solar + storage systems to operate independently from the grid during an outage, is incorporated into these systems to give them the capability to continue functioning even when the grid is down.
9	Emergency Preparation: Procedures and protocols are developed and implemented for how the resilience hub will operate during an emergency, including how it will provide community resilience services to the community.
10	Outage Detection and Response: When a power outage occurs, the system automatically disconnects from the grid and transitions to using the locally stored solar power.
11	Power Provision during Outage: During an outage, the resilience hub continues to provide community resilience services, using power from the storage system to maintain operations. Services such as weatherization can help maintain safe indoor temperatures.
12	Post-Outage Reconnection: Once grid power is restored, the system automatically reconnects to the grid, resumes normal operations, and recharges the energy storage unit.

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Stakeholder Roles in Commercial Solar and Solar + Storage Use Cases

The roles and responsibilities of stakeholders, including communities, utilities, building owners, and local government, involved in the four use cases presented are distinct yet interconnected.

The Role of Communities, Community-Based Organizations, Utilities, and Building Owners

Table 5 delineates the roles between communities, utilities, and building owners, offering insight into how each stakeholder contributes to the overall effectiveness and efficiency of solar and solar + storage installations, and highlighting the synergies that can be harnessed when these entities collaborate effectively. Please note that while the primary responsibility for implementing and executing these programs to benefit communities is that of resourced decision makers (such as electric utilities in collaboration with local governments), Table 5 offers complementary roles that communities and community-based organizations can assume to ensure their perspectives are represented in the design and delivery of these programs.

Table 5: The Roles of Stakeholders in Commercial Solar and Solar + Storage Use Cases

Communities & Community-Based Organizations	Utilities	Building Owners
Promote solar adoption and raise awareness about the benefits of renewable energy.	Assist in navigating and ensuring compliance with regulations.	Manage and secure financing for the installation of solar or solar + storage systems.
Advocate for supportive policies and regulations for clean energy initiatives.	Oversee the process of incorporating solar and solar + storage systems into the grid, managing interconnection complexities.	Research and plan for effectively meeting local plan review and utility interconnection specifications and plan documentation requirements.
Facilitate conversations between the community, building owners, utilities, and other stakeholders (such as solar installers).	Offer tailored rates and on-bill compensation programs to encourage solar and solar + storage installations.	Oversee project management, secure necessary financing, and engage technical support to address installation and operational costs.
Identify suitable locations for resilience hubs in Use Case 4. Foster community preparedness and resilience during emergencies in Use Case 4.	Provide financial incentives, grants, or loans to support solar adoption and ease upfront system installation costs.	Take advantage of the utility's compensation mechanisms and rates, maximizing bill savings in Use Cases 1 and 2.
Foster community preparedness and resilience during emergencies in Use Case 4.	Collaborate in system design and grid interconnection in Use Cases 3 and 4.	Take an active role in system maintenance, repair, monitoring, and optimization in Use Cases 3 and 4.
	Help identify critical services and craft emergency response plans in Use Cases 3 and 4.	Ensure continuity of essential services during power outages for Use Cases 3 and 4.

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The Role of Local Government

Local governments can play a role that is integral in the orchestration of the four use cases, especially in community resilience. They can bridge the gap between utilities, building owners, and communities, ensuring streamlined operations and effective communication. Local governments can own buildings and can even serve as utilities in the case of municipal utilities, directly impacting the establishment and maintenance of resilience hubs. They can identify and convert public facilities like schools and community centers into these hubs, which are equipped with solar + storage systems to ensure power continuity during emergencies.

Collaboration is essential. Local governments can update and refine their local policies and processes to foster a conducive environment for solar market sustainability. For instance, incorporating solar energy considerations into local codes and ordinances boosts solar accessibility and deployment. This also involves streamlining photovoltaic (PV) permitting and inspections, accelerating the pace at which businesses and residents can install and operate solar panels. Ensuring clarity and transparency throughout these processes guarantees solar penetration into traditionally underserved areas. While utility interconnection standards and electricity rate structures might often lie beyond the purview of local governments, partnerships can still be forged to influence these areas. Local governments, by cultivating these relationships, ensure resilience hubs are not merely operational, but also optimally positioned and equipped to cater to their communities during crises.[xiii, 13]

[xiii] This discussion draws insights from the US Department of Energy (DOE) Solar Energy Technologies Office (SETO). The SETO has crafted resources to aid local government officials and stakeholders in propelling solar deployment. For a more in-depth understanding and exploration of field-tested approaches in various American cities and counties that effectively reduce market barriers, refer to the *Solar Power in Your Community* guidebook, updated in 2023 by SETO.

Supportive Utility Offerings

Having explored the four use cases and the roles of key stakeholders, this section delves into the different kinds of support utilities can provide. Table 6 illustrates a variety of ways utilities can facilitate the implementation and operation of these systems. A more detailed list of these offerings can be found in *Appendix B: Supportive Utility Offerings*.

Table 6: Supportive Utility Offerings for Solar and Solar + Storage

	Rebates and Grants	Compensation and Rates	Financing Arrangements	Technical Support and Infrastructure
What benefits can these types of offerings provide?	Financial assistance that helps reduce the upfront costs of solar and solar + storage systems.	Pricing structures that help customers optimize their energy usage and reduce their energy bills.	Financing to spread the upfront costs of installing solar and solar + storage systems over time.	Technical services to facilitate the integration of solar and solar + storage systems into the grid.
Which use cases do these offerings support?	Bill Savings, Outage Survivability, and Community Resilience	Bill Savings	Bill Savings, Outage Survivability, and Community Resilience	Bill Savings, Outage Survivability, and Community Resilience
How are these utility offerings defined?	Rebates and grants are financial incentives offered by utilities to reduce the initial installation costs of solar and solar + storage systems. In addition, utilities may help to surface and combine additional funding sourced from utilities, government programs, or philanthropic organizations.	Compensation Mechanisms: Rewards customers for the services supplied to the grid from their solar and storge systems, which affects the financial incentive to adopt these technologies. Rates: These define the costs customers pay for electricity (including the connection to the grid) and play a pivotal role in the affordability and adoption rate of solar technologies.	Financing arrangements offered by utilities facilitate the adoption of these systems by alleviating the burden of upfront costs for customers. Leasing options enable access to these systems without ownership, providing flexibility and immediate access to renewable energy.	Technical support and infrastructure services simplify the installation and upkeep of solar and solar + storage systems. They include design guidance; installation assistance; help with regulations, maintenance, and troubleshooting; and support for grid interconnection and resilience planning, ensuring systems perform reliably and effectively.

During SEIN's Round 2, the Georgia-based “Breaking Barriers to Resilience in the AUCC” project (Breaking Barriers), offered a real-world illustration of how utilities can contribute to the deployment and operation of solar + storage systems.[14] The instrumental role played by the local utility, Georgia Power Company (GPC), highlights its capability to support community resilience and energy independence initiatives.

SEIN Teams' Experience: Utility Support for Solar + Storage Microgrid for Community Resilience

As part of Round 2 of SEIN, the Breaking Barriers project, a collaborative effort involving Groundswell, Partnership for Southern Equity, Spelman College, Morehouse College, and the Atlanta University Center Consortium (AUCC), embarked on a project to enhance electricity resilience.[15] The effort focused on enhancing resilience to outages at four Historically Black Colleges and Universities in the West Atlanta neighborhood of Atlanta, Georgia, and the surrounding community. The goal was to design and construct innovative **urban energy resiliency hubs by integrating microgrid technology, solar generation, and energy storage**, thereby addressing the unique energy challenges faced by these communities.[xiv]

A key aspect of the project's success was the **early and active involvement of Georgia Power Company (GPC)**, the local utility. Recognizing the importance of utility participation in energy projects of this scale, the Breaking Barriers team brought GPC on board as a project advisor. GPC committed staff resources from its Resiliency Division and Distributed Energy and Renewables Division to the project, contributing essential **resilience planning** guidance.

Furthermore, GPC provided crucial **technical assistance and rate structure information**, both vital for developing the project and estimating its economic performance. Their expertise helped navigate the complexities of integrating the solar + storage systems with the existing grid, ensuring that the energy systems would perform as planned after being installed. Additionally, their insights on rate structures were instrumental in supporting the community's understanding of the project's financial feasibility.

The collaboration between the Breaking Barriers project team and GPC exemplifies the role utilities can play in supporting solar + storage systems deployment. However, GPC's involvement reflects their specific commitment to this initiative, and the degree of utility engagement can vary. Despite these variations, this project underscores the importance of early utility involvement.

[xiv] See the definition of microgrid in *Appendix E: Technical Glossary*.

Guidelines for Effective Collaboration between Utilities and Community-Based Organizations: Meeting Your Community's Needs through Collaboration

Why: The Value of Community-Utility Collaboration to Meet Community Needs

Collaborating with electric utilities offers an opportunity for both under-resourced communities and their dedicated community-based organizations (CBOs) to foster access to clean energy, empowering residents while harnessing associated benefits in service of community needs. By partnering with utilities, they may be able to overcome funding, technical, and regulatory barriers to access solar and solar + storage microgrid initiatives.

Through community-utility collaboration, utilities can gain valuable insights into the unique needs and challenges of underserved communities, enabling them to customize their services to strengthen program enrollment. Where applicable, effective engagement with communities can also support utilities in achieving their corporate equity goals, to answer requests from their regulators, or succeed in state or local mandates.

This collaborative approach can move beyond nominal inclusion toward shared leadership over an affordable, accessible energy future. By building resilient partnerships that acknowledge historic distrust, utilities can transform their relationships with communities and prioritize their needs in these programs for commercial buildings.

The presence of an energy-focused, place-based organization (an "energy champion") can play a vital role in translating and fostering connections between communities and their utilities. Some attributes of such organizations may include:

1. An understanding of the purpose and goals of the utility, including the background and context to comprehend utility plans and procedures.
2. The ability to work effectively within the community to understand and articulate their specific needs.
3. Existing relationships, or a willingness to build relationships, with one or both parties.

While organizations playing this role may have some subset of these attributes, they must have a willingness to work toward them. The primary goal of the energy champion is to enhance understanding, cooperation, and the overall success of clean energy initiatives.

The role of the energy champion
The SEIN Round 3 team *Driving Resilient and Economic Solar & Storage in Salt Lake City's Historically Underserved Communities* leveraged Utah Clean Energy, a nonprofit with strong relationships between the utility, solar and battery installers, and community businesses, as an energy champion. Their goal was to address solar + storage market barriers and energy injustices through collaboration and resource building with community members and trusted stakeholders, creating opportunities for the implementation of healthy and affordable energy systems. Utah Clean Energy led the effort of the team to encourage changes to utility programs and improve community business owners' understanding of the economic viability of solar + storage systems.

For more details on this collaboration, refer to the SEIN Teams' Experience: Driving Resilient and Economic Solar & Storage in Salt Lake City's Historically Underserved Communities in the *Options for Adapting Utility Programs to Meet Community Needs* section of this report.

In this section, we delve into the value of effective collaboration between CBOs and utilities to support overburdened communities. This section begins by describing how utilities can meet community needs through collaboration. The guide will then provide methods for adapting utility commercial solar + storage programs to meet identified community needs, whether through more effective communication, improving program design, or creating new programs entirely.

What: Community Needs Can Begin to Be Addressed by Commercial Solar and Solar + Storage Microgrids

The SEIN Round 3 project teams sought to address challenges to the equitable adoption of solar, with half of the teams focusing on commercial solutions, which could include solar + storage. These teams, from Port Arthur, TX, to Salt Lake City, UT, and beyond, actively responded to specific needs in their communities, like empowerment and leadership for BIPOC communities, resilience in historically underserved neighborhoods, or workforce development. The collective insights and visions of these teams illuminate the potential of commercial solar and solar + storage. Table 7 below further explores some of the community needs that SEIN Round 3 teams sought to address and how commercial solar and solar + storage can begin to address them:

Table 7: Community Needs That Can Be Addressed by Commercial Solar and Solar + Storage Microgrids

Community Need	Relationship to commercial solar and solar + storage microgrids
Affordability	Commercial solar and solar + storage can lead to lower energy costs for businesses, enhancing energy affordability for business owners. When implemented alongside the supportive utility offerings examined in Section 1 these systems can help stabilize energy bills, protecting businesses from volatile market fluctuations.
Outage Survivability and Resilience	By providing a backup source of power, commercial solar + storage microgrids can help curb the effects of power outages. Power outages can have severe consequences on community health and well-being, limiting access to heating, cooling, refrigeration, and medical equipment during times of extreme weather.* This lack of access to essential resources can pose serious health risks, particularly for vulnerable populations, especially BIPOC communities.† Implementing commercial solar + storage microgrid solutions can enhance power outage survivability by providing backup energy, reducing dependence on the grid, and ensuring sustained access to critical services.‡
Workforce development	Implementing commercial solar and solar + storage projects can create job opportunities, supporting workforce development within communities.§ The installation, operations, and maintenance of solar and energy storage systems require skilled labor. By investing in workforce training programs and job creation initiatives, community members can grow the skills to participate in the growing clean energy sector. This, in turn, stimulates economic growth, empowers individuals with sustainable employment, and contributes to the long-term development of the community. While the other benefits in this table can be designed to be direct benefits of these technologies, workforce development must be explicitly designed into these programs if the benefits are to be realized by the local community. This could include working with local organizations, universities, and technical schools to stand up jobs training programs. See the SEIN Teams' Experience: Solar for Safety and Success (3S) team on the next page of this report to learn more about how a SEIN Round 3 team designed their solar program to support workforce development.

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Notes on Table 7:
** The health impacts of power outages include increased risks of heat-related illnesses, compromised access to medical care, medication storage and refrigeration challenges, disrupted access to clean water, and mental health consequences due to prolonged discomfort and stress.* [16]
† Lack of access to essential resources poses a disproportionate risk to under-resourced communities, particularly BIPOC populations, due to factors such as limited access to cooling infrastructure, higher population density, and socioeconomic vulnerabilities. [17]
‡ See the definition of islanding in Appendix E: Technical Glossary*.*
§ Given the projected 27% growth in employment of solar photovoltaic installers from 2021 to 2031, it becomes increasingly important for solar project teams to support job training programs in solar PV installations.[18]

Communities can also use these technologies to begin to support restorative benefits, such as health and environmental justice and local empowerment.[xv, 19] Commercial solar and solar + storage must be deployed at scale alongside fossil fuel plant retirement to mitigate air pollution and emissions for overburdened communities close to these facilities. Communities can work to change the ownership structure of the solar and/or battery energy system programs, which could support additional local autonomy.[xvi, 20]

How: Community Organizations Can Prepare for Conversations with Utilities to Drive Programs to Meet Community Needs

The following steps are designed to support community organizations that are entering conversations with their electric utilities, motivated by RMI's work with SEIN teams requiring conversations between CBOs and electric utilities. While we are *not* suggesting that these communities be asked to carry the burden of undoing historic injustices, this section offers a strategy to support them in accessing existing programs to harness the benefits of solar initiatives and investments. This section provides guidance on how community organizations can strategically prepare for and navigate these conversations to access and drive programs that address the unique needs of their communities.

Step 1: Conduct a community energy/solar needs assessment
CBOs have an intimate understanding of the local context and community member concerns, including affordable housing, living wages, food scarcity, and other concerns in vulnerable communities. A deeper dive to assess the community's energy needs, priorities, and challenges may be needed if the CBO does not already have this context.[21] This can include evaluating energy affordability, existing energy burden, the need for resilience, environmental justice concerns, job creation, and community empowerment specifically in the context of commercial solar and solar + storage microgrid programs.

SEIN Teams' Experience: Solar for Safety and Success (3S) team, led by Houston Advanced Research Center
The SEIN Round 3 Solar for Safety and Success (3S) team in Port Arthur, Texas, engaged in a robust community energy needs assessment process to understand the community's experience

[xv] Restorative benefits refer to the positive outcomes and reparative effects that can be achieved through the application of restorative justice principles in addressing the harmful impact of the historic energy system on underserved communities, such as financial and environmental burdens.
[xvi] RMI's *Finding Value in the Energy Future* report explores different ownership structures of solar and relevant energy efficiency projects between the utility and community on page 19 and in subsequent case studies, referred to as Models.

with outages and survey what benefits the community wanted to see out of their Resilience Hub program.[22] They deployed several engagement strategies to understand the community's needs including social media postings, door-to-door canvassing, public community meetings, letters, and postcards. They also engaged with city leaders and actively participated in city council meetings with the support of project partners. Through these efforts, the team discovered that the initiatives offering participation incentives received the most community interest. For instance, an online survey that provided incentives received 100 responses, and the highest attended community meeting was one that featured raffle prizes and a barbecue dinner provided by a local restaurant. [xvii, 23]

Note: If in the process of conducting needs assessments the CBO discovers that the community may not have a clear understanding of their energy needs, the CBO can help by:

1. Supporting community education on the potential benefits of commercial solar + storage (as listed in Table 7).
2. Addressing common concerns of commercial solar + storage for business owners or bringing these concerns to the utility.[xviii, 24]
3. Providing real-world examples from other communities or businesses that have implemented commercial solar + storage projects, highlighting how these projects have addressed similar energy challenges and brought tangible benefits to those communities.

Step 2: Research existing utility and government policy programs.

To understand the offerings and initiatives available, community organizations, working alongside their energy champion (as defined in the section titled *Why: The Value of Community-Utility Collaboration to Meet Community*) can begin researching utility programs by:

- Exploring communitywide policies within local general planning, sustainability, resiliency, and emergency preparedness plans that support renewables and clean energy transformative goals.
- Exploring the utility's official website, looking for sections dedicated to renewable energy programs, solar incentives, energy storage, demand response, and community engagement.
- Reviewing program descriptions, eligibility criteria, application processes, and available financial incentives.
- Paying attention to any programs designed for underserved communities or those promoting energy equity and environmental justice.

The utility may not publish all this information on its website. Step 4 in this guide offers advice on finding key contacts at the utility, which can help to address this situation.

Considerations. When preparing questions for the utility, it is essential to consider the context in which the utility operates and how its responses can guide community organizations in addressing their needs. The Initiative for Energy Justice's *Utilities 101: A Guide to the Basics of the Electric Utility Industry with a Focus on Justice* serves as a valuable resource for organizations to understand the

[xvii] More information on the 3S team's work to engage the community can be found on their website, see endnote.

[xviii] For example, Colite Technologies addresses many of the common concerns with commercial solar, as a starting point.

utility context.[25] This guide provides essential information about the electric utility industry, its structure, history, and key concepts related to justice.

Some background on the following utility contexts will support productive conversations, including:

- Utility type: Whether it is an investor-owned utility, a municipally owned utility, or a cooperative.[xix, 26]
- Regulatory context: Whether it is regulated in a vertically integrated or restructured state.[xx,27]
- Business model: What incentives (e.g., performance-based regulation), state policy requirements, or corporate policies are available to motivate the utility to meet community needs?[xxi, 28]
- Federal policy context: What enabling incentives are available for the utility to pursue community-supportive investments (see Table 8 of this report)?

As of 2023, the Inflation Reduction Act (IRA) authorized a revised Investment Tax Credit (ITC) to incentivize programs like those discussed in this paper, enabling solar owners to claim federal tax credits for 30% of the total project cost with additional tax credits for certain equity provisions (see Table 8 below).[xxii, 29] These equity adders can help to meet community needs when leveraged effectively. For example, an additional 20% Low Income Adder can be applied to qualified projects that supply at least 50% of the financial benefits of the electricity produced to low-income households.[xxiii, 30]

Community groups and energy champions will have more successful conversations with utilities if they bring an awareness of the utility's context and any relevant enabling policies.

[xix] Types of utilities in the United States are defined in the table on page 2 of the Initiative for Energy Justice's *Utilities 101* guide.

[xx] The National Governor's Association Electricity Markets 101 landing page explains the basic differences between regulatory contexts in the section entitled "What Is the Difference Between Vertically Integrated and Restructured Electricity Markets?"

[xxi] RMI's article "States Move Swiftly on Performance-Based Regulation to Achieve Policy Priorities" has more information on utility business models.

[xxii] More information about the Investment Tax Credit and its adders can be accessed in the RMI webinar *Empowering Communities with Solar: How to Leverage IRA Opportunities at Scale*.

[xxiii] Low-income households, in this context, refers to those that have an income of less than 200% of the poverty line or less than 80% of the area median gross income.

Table 8: Notable Investment Tax Credit (ITC) provisions for Commercial Solar + Storage Projects

ITC Provision	Description
Energy Communities Adder	A 10% bonus tax credit for solar projects sited in "energy communities," including brownfield sites, areas with significant fossil fuel employment or tax revenue, and coal closure categories.
Domestic Content Adder	A 10% bonus tax credit for solar projects that use US-sourced materials, including structural steel and a percentage of US-made products.
Low Income Adder	A 10% bonus tax credit for solar projects under 5 MW located in low-income communities or on Tribal lands. Alternatively, a 20% adder for projects on low-income residential buildings or providing benefits to low-income communities.
Prevailing Wage and Apprenticeship Requirements	To qualify for the base (30%) tax credit, all projects over 1 MW must meet prevailing wage payments and a percentage of labor hours by qualified apprentices.

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For more details on these ITC provisions, please see Appendix C: Available Federal Financing Opportunities.[31]

Step 3. Conduct a "gap analysis."

Using the research conducted in steps 1 and 2, CBOs, while consulting their energy champion, can conduct a gap analysis in two steps:

1) Assess how well the existing programs align with community-identified needs and priorities.
2) Reflect on how existing programs might provide community benefits, or how they might need to be altered to do so.

Understanding the experience of businesses that have explored solar installation or participation in an existing utility program can provide valuable insights into the application process and realities of program implementation. To identify these businesses, the energy champion may:

- Identify what evaluation, measurement, and verification and/or market research studies may have already been conducted for solar programs and are publicly available. Process evaluations may be particularly helpful to identify how the program works and impact evaluations can help understand the range of potential savings and what type of customers it has successfully served.[32]
- Reach out to business associations, chambers of commerce, and industry-specific organizations for leads on businesses involved in utility programs.

- Attend networking events, conferences, and workshops focused on renewable energy or sustainability to connect with businesses that have explored utility programs.[xxiv]
- Seek partnerships with organizations or initiatives involved in renewable energy adoption to gain access to businesses in the target community.
- Utilize online platforms, forums, or social media groups related to sustainable energy to identify businesses that have attempted to adopt utility programs.
- Plan to discuss program enrollment and identify potential businesses with the utility in first conversations.

Step 4: Identify key contacts at the utility.

To get the conversation started with the utility, the community organization could attempt to identify utility employees that lead programs for vulnerable communities and other potential programs of interest. This can be a challenge as utilities can be large and siloed organizations. In addition to working with an energy champion to identify the right contacts at the utility, a community organization can:

- Verify what community engagement activities or programs the utility already offers.
- Check for utility-sponsored events, educational workshops, or public meetings related to renewable energy, sustainability, equity, and specific connections with under-resourced communities. These gatherings often provide opportunities to interact with utility representatives and identify the appropriate contacts.
- Engage with local energy organizations, community groups, or industry associations that have connections with the utility.
    - Depending on their previous experience with the utility, the energy champion may be positioned to initiate a conversation with the utility and identify the right person/department for engagement.

Step 5: Prepare for conversation with utilities.

Some community organizations may want their energy champion to join or entirely represent them in initial conversations with utilities. This will allow the energy champion and utility to go into the deep details of utility policies, regulations, and programs, which the energy champion can share with the community organization. If the energy champion does take on this conversation, they must support the crucial task of representing the community's lived experiences and needs to the utility, so the utility can understand the context in which the community is seeking collaboration.

[xxiv] An increasing number of these events are providing registration fee waivers, travel, and/or lodging stipends to support attendance of underserved communities.

Table 9 offers some example questions, information the utility may provide, and potential actions community organizations can consider.

Table 9: Questions for Community-Utility Conversations

Question for the utility	Potential utility responses	CBO actions
What financial incentives/technical support are available to assist in implementing these technologies?	Information on financial incentives, grants, or low-interest financing options available to support community organizations in these programs. Technical support offers, such as guidance on system design, interconnection processes, or energy management.	Use information to assist in securing necessary funding, accessing technical assistance, or leveraging resources to advance these programs.
How does this [existing solar or solar + storage microgrid program] work? What are the eligibility criteria and application process? Are government-owned or nonprofit owned installations eligible?	Details on their solar and solar + storage microgrid programs, including eligibility requirements such as system size limitations, location restrictions, or customer classifications. Details on application process, required documentation, and any associated fees.	Review the eligibility criteria to determine if it aligns with their community's needs to determine how eligibility criteria restrict or enable participation from their target community. In subsequent meetings, discuss potential modifications or alternative pathways to participation.
How will/has the utility engaged with underserved communities thus far on this program or similar programs?	Details on outreach and engagement strategies used thus far or planned. Details on communities of interest.	Use the information to understand where the utility may need to improve its tactics to reach the appropriate communities.
What specific regulatory or policy constraints impact this program?	Context on the regulatory landscape in which they operate, including any limitations imposed by state or local regulations. Clean energy goals, net energy metering, interconnection, utility rates, or other pricing structures.	Build these constraints into program and local energy campaign planning efforts to collaborate with regulatory bodies, answer detailed questions about policies and their impact on socially vulnerable communities, or explore alternative strategies to address community needs within existing regulatory frameworks.
How does the utility evaluate its program adoption in underserved communities? How does the utility incorporate this information into program design and outreach?	Strategies for outreach, monitoring and evaluation, engagement, and partnerships with community-based organizations and other stakeholders working with underserved communities.	Guide further discussions on potential collaboration, identify areas for improvement, or explore opportunities for joint initiatives that specifically address the needs of socially vulnerable communities.
What considerations does the utility face when making updates to these programs? Are there any specific considerations, now or in the future, that might target overburdened populations?	Timing constraints, program or tariff approval cycles, rate cases, and regulatory requirements. Program modifications align with the utility's long-term planning and budgeting processes.	Align their engagement strategies with key milestones, engage in public comments or regulatory proceeding opportunities, or make timely updates to programs that address their community's needs.*

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Notes on Table 9:

**** Participation in regulatory proceedings or other forms of advocacy may require legal representation, specifically in the case of litigated proceedings. This set of actions should only be considered for CBOs that are mission aligned with this type of work, and it is important to note that such engagement can be costly in states where there is not intervenor compensation (for more details on intervenor compensation policies, see NARUC, 2022, "State Approaches to Intervenor Compensation").***[33]

Step 6: Collaborate to Enhance Program Alignment.
Based on the utility's responses, collaborate to identify potential areas for improving existing programs and aligning them with underserved community needs. Explore opportunities for partnership and joint initiatives to enhance program effectiveness to meet community needs. Consider the potential for co-designing new programs or tailoring existing ones to better meet the community's unique requirements and priorities. The *Options for Adapting Utility Programs to Community Needs* section on page 30 explores co-designing efforts in depth and provides examples for how to do so effectively.

For Utilities: Engaging Your Community: Guidelines for Effective Collaboration

How Utilities Can prepare for Conversations with CBO Partners to Drive Programs to Meet Community Needs

By following these steps, utilities can foster meaningful engagement and create impactful programs that align with community priorities.

Step 1: Prepare to listen.
Initiate a collaborative and comprehensive engagement process by convening with CBOs and community government leaders to better understand their perspectives, individual contexts, and concerns. It is crucial to recognize that these concerns may extend beyond the realm of energy, and yet, listening with genuine intent is the foundation upon which successful collaboration is built. The practice of listening is the cornerstone of effective and enduring partnerships. It not only serves to unearth the intricacies of community needs but also cultivates trust and credibility, prerequisites for any impactful collaboration, enabling utilities to deliver their programs effectively to historically underserved communities.

Step 2: Review existing solar and solar + storage programs and policies for commercial buildings.
To prepare for conversations with CBOs, utilities can begin by evaluating their current programs and policies specifically designed to promote commercial adoption of solar, solar + storage, and solar + storage microgrids to assess their alignment with potential underserved community needs. They will also need to take stock of any emerging programs for areas where there are gaps. Using this information, utilities can come prepared to have conversations with the community, understanding what outcomes these programs can help to address. In their review, the utility may then choose to focus on factors their communities may have identified as priority needs, such as energy affordability, existing energy burden, the need for resilience, environmental justice, job creation, and community empowerment specifically in the context of these programs.

Step 3: Track solar, solar + storage, and solar+ storage microgrid program uptake in commercial buildings in underserved communities.
To ensure the effectiveness of programs and address equity concerns in conversations with communities, utilities can gather data and understand program uptake in commercial buildings within various underserved communities by census tract. This information can help utilities prepare for conversations with community organizations so they can understand program uptake, address potential barriers to access, and partner with community organizations to help articulate program benefits to their target communities.

Step 4: Collaborate on program improvement strategies.

Utilities with the greatest success of providing benefits to overburdened communities continuously engage with the community and their CBOs to gather feedback on commercial solar and solar + storage program effectiveness and identify areas for improvement to meet community needs. Actively involve community stakeholders in program planning and evaluation processes, including participation in working groups, advisory committees, or pilot projects.

In the context of commercial solar or solar + storage, this step could involve designing incentive programs tailored for BIPOC businesses, creating educational initiatives to demystify technical challenges, and jointly developing outreach strategies with CBOs to engage potential business participants in overburdened communities. For example, Washington state's investor-owned utilities each set up Equity Advisory Groups, made up of community leaders (such as CBO leaders and/or local government leaders) from various underserved communities to advise the utility on program development across a range of technologies.[xxv, 34]

Additionally, utilities could collaborate with these organizations to advance regulatory changes that simplify the process for BIPOC businesses in under-resourced communities to install and benefit from these technologies.

While collaborating on program improvement strategies, utilities may encounter certain limitations that can hinder the process. However, with proactive measures and potential support from utility regulators, these limitations might be able to be overcome. Here are some common limitations and potential ideas on ways for utilities to address them:

[xxv] Equity Advisory Groups from Avista, Pacific Power, and Puget Sound Energy are examples of how utilities can engage community leaders on these issues.

Table 10: Potential Barriers to Program Adaptation That Utilities Can Address to Meet Community Needs*

Potential utility barriers	Strategy to overcome barrier
Limited resources, including budget constraints or staff capacity	External funding, such as grants or partnerships, to support collaborative efforts and address gaps where ratepayer or shareholder funding is not an appropriate source of funds or unavailable. Engaging with community organizations, local governments, or other stakeholders can help share the workload and tap into community expertise to drive program improvements.†
Regulatory/legislative constraints, limiting flexibility	Actively engage with regulatory authorities and advocate for flexible and adaptive regulatory frameworks that allow for timely adjustments to these programs. Collaborate with community organizations to identify opportunities for promoting equitable program design and implementation. Offer proposals to regulatory agencies that demonstrate how community input was considered in program design. In proposals, ensure that costs to fully address ongoing community engagement are included as part of program implementation, adjustments, or cyclical planning efforts. Where regulators offer opportunities for feedback on equity in their practices, the utility might decide to ask that regulatory agencies consider CBO and equity consideration input in their own decision-making. ‡
Stakeholder resistance from utility executives, board members, or staff §	Foster a culture of collaboration within the utility by promoting open dialogue, actively listening to stakeholder concerns, and highlighting the benefits of community engagement and solar and solar + storage program design improvements that support an increase in equitable energy for overburdened communities. Engage in internal education and training sessions to build awareness and understanding of the value of community collaboration in driving positive outcomes. Encourage a shared vision and commitment to equity and community empowerment among internal stakeholders by adopting a company-wide environmental/energy justice position statement or commitment.
Communication and engagement challenges due to historic relationship issues	Invest in effective communication strategies, such as community outreach programs, stakeholder meetings, or online platforms, to ensure transparent and accessible information sharing about commercial solar and solar + storage programs.** Include expectations for future follow-up and how input will be used. Measure the success of such strategies with clear metrics informed by conversations with community members, government officials, and CBOs. Utilize cultural competence and linguistic support to bridge communication gaps and ensure all voices are heard in public forums, in outreach materials, and on online platforms.

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Notes on Table 10:
** The barriers described herein have been compiled based on RMI's experience collaborating with electric utilities as a part of both our consulting and Electricity Innovation Lab experience.* [35]
† These stakeholders, especially community-based, nonprofit organizations, likely will not have resources for this type of work and may need support in securing funding to do this work.
‡ Public utilities commissions in multiple states, including Colorado and Hawaii, are exploring dockets and proceedings to holistically integrate equity into their regulation of utilities.[36]
§ Please note that lack of leadership support may be a significant barrier when creating these programs. Leadership involvement in this process, including in discussions with communities, may be a helpful tactic in overcoming this barrier.
*** Portland General Electric's Distribution System Planning Part 1, Chapter 3: Empowered communities: Equitable participation in distribution decisions section entitled "3.4.3 Best Practices" outlines a series of best practices for community engagement to increase accessibility and relevancy to communities for more effective engagement. These strategies include but are not limited to providing childcare options during meetings, locating close to public transit, and providing language interpretation services.* [37]

Step 5: Create new programs as needed. If these steps to improve existing solar and solar + storage programs are still insufficient to address community needs, utilities could consider opportunities to create new programs that directly address community needs and priorities. Consider innovative approaches, such as community solar initiatives, energy equity funds, or targeted workforce development programs. Collaborate with community organizations and stakeholders to design and implement these new programs, ensuring they align with community aspirations and promote energy justice.

Options For Adapting Utility Programs to Meet Community Needs

Communicating about existing programs and adapting utility programs to meet underserved community needs requires a collaborative approach that goes beyond traditional offerings. Unmet needs and insufficient enrollments present challenges for both communities and utilities. This section discusses potential strategies for communicating about existing programs and adapting and improving existing programs.

Communicating about existing programs

Many state, federal, and utility programs exist to help underserved communities access reliable and affordable energy, but underutilization, especially in BIPOC, LMI, and other underserved communities, remains a significant challenge.

This underutilization problem exists in many contexts, beyond SEIN team communities alone. For instance, Pacific Gas & Electric (PG&E) has implemented the Family Electric Rate Assistance program (FERA), which provides an 18% reduction in energy bills for income-qualified households.[38] FERA-eligible households can also benefit from the Energy Savings Assistance Program, which offers free energy efficiency upgrades to their homes.[39] However, despite the potential benefits, the enrollment rate in these programs among eligible households in PG&E's jurisdiction remains below 25%.[40]

Low enrollment not only hampers the effectiveness of these initiatives but also highlights a gap in utility-community communication or accessibility.[xxvi, 41] By establishing trusted partnerships with community organizations and energy champions, utilities can effectively communicate the existence and benefits of these programs to target underserved communities and support their enrollment. The Round 3 SEIN team *Advancing Small Business Solar Equity*, located in Minneapolis and St. Paul, MN, is creating a network for communicating with trusted organizations about incentive programs and resources for solar. This is a first step in creating a network of practitioners that can provide feedback on the design of utility programs.

SEIN Teams' Experience: Advancing Small Business Solar Equity in Minneapolis and Saint Paul, Minnesota

The Round 3 SEIN *Advancing Small Business Solar Equity* team located in Minneapolis and Saint Paul, MN, (the Twin Cities) has ambitions of empowering BIPOC- and immigrant-owned businesses in their community to begin to address inequities in solar adoption and use solar as a tool to increase business resilience and build capacity to sustain ongoing community action.

The team, led by Lake Street Council (a nonprofit business support organization for the Lake Street corridor of Minneapolis), used human-centered design to understand their community's experience with solar and access to solar incentive programming.[xxvii, 42] Through **extensive research and interviews with small business owners, solar installers, and solar experts**, the team gained insights into the **specific barriers to solar adoption faced by BIPOC and immigrant communities** in the Twin Cities.

Through this engagement, the team identified that there is already a relatively robust network of financial incentives available for businesses that choose to install solar, including incentives and rebates at the local, state, federal, and utility levels. However, the communications channels needed to ensure awareness of incentives among BIPOC and immigrant communities were lacking. To remedy this, the team is partnering with the **existing network of CBOs** that already serve small businesses to **enable them to provide resources, education, and technical assistance as a trusted messenger**.

By fostering engagement between stakeholders along the delivery path of commercial solar projects, including solar installers, lenders, and CBOs, this network aims to support effective and equitable access to Xcel Energy's solar incentive programs and other pathways for solar adoption in the Twin Cities.

Collaborations with CBOs are crucial in overcoming barriers to utility program enrollment, like lack of awareness and complex application processes. To address a **lack of program awareness**, CBOs can conduct surveys, talk to potentially eligible customers, or host listening sessions to gauge the underserved community's level of awareness about utility programs. Through this process, CBOs may uncover reasons for unfamiliarity with programs, which could include things like inconsistent

[xxvi] ESource's *5 questions utilities should consider at the intersection of energy affordability and equity* explores program under-enrollment, the effect on energy equity, and how utilities can begin planning for more affordable and equitable outcomes for their customers.
[xxvii] Human-centered design is a creative problem-solving approach that begins by understanding the needs of the intended users, involves ideation and prototyping, and culminates in tailored solutions that empathize with and cater to those users.

information on a utility's website, lack of access to online resources, materials in need of translation, etc. The utility can then more effectively develop an outreach campaign tailored to the underserved community's needs in a manner that is culturally and linguistically accessible to the underserved community.

To address a **complex application process**, CBOs can gather feedback from community members who have tried to enroll. If the application process for a solar incentive program is filled with technical jargon, homeowners could be confused. The community organization can work with the utility to simplify the application language and process, perhaps through a step-by-step guide to the application process, providing direct assistance to help applicants, or streamlining the process to make it more user-friendly. Deep engagement requires investment and can offer significant benefits, enabling bidirectional conversations to improve utility programs and increase enrollment for underserved communities.

Improving existing programs

Improving existing utility programs to meet community needs may require addressing both issues related to customer awareness and program design itself, recognizing underutilization may stem not only from communities' lack of knowledge about existing programs but also from inherent program design barriers that hinder customer participation.

An illustrative example of how utilities can improve existing programs to better meet community needs comes from the Round 3 SEIN Salt Lake City team detailed below. This team identified and began to address a significant gap in the uptake of a commercial battery incentive program, demonstrating the importance of understanding the specific barriers faced by different segments of the community.

SEIN Teams' Experience: Driving Resilient and Economic Solar + Storage in Salt Lake City's Historically Underserved Communities

The Round 3 Solar Energy Innovation Network (SEIN) *Driving Resilient and Economic Solar & Storage in Salt Lake City's Historically Underserved Communities* team was led by the Salt Lake City Department of Sustainability with support from climate and clean energy expert Utah Clean Energy and minority business advocate Suazo Business Center.

This SEIN team identified a gap in uptake in commercial solar + storage projects across Salt Lake City, specifically lower uptake within BIPOC and immigrant neighborhoods than in higher income areas of the city. To bridge this gap, the team engaged with community members, trusted stakeholders, and battery installers to explore project opportunities with BIPOC-owned businesses to identify and address barriers to solar and storage adoption.

Through this engagement, the team identified specific challenges faced by community business owners. These barriers included lack of information, lack of appropriate financing mechanisms for BIPOC-owned businesses, and a mismatch between the utility battery incentive program and small-business needs. For example, a primary use case for a customer-owned battery is to shave peak energy consumption to reduce demand charges. However, the utility battery program terms and conditions did not provide sufficient clarity about how the utility would use the customer battery and whether customers could rely on their battery to provide the desired peak shaving.

The team also suggested an adjustment to the battery program structure to compensate customers if the utility prevented them from reducing their own peak demand. In response, the utility is considering redesigning its program to better cater to the needs of commercial battery owners and improve the use case.

Co-Creating Utility Programs with Overburdened Communities

While most SEIN teams today have focused on the first two program improvement strategies, there may be a need to create entirely new programs when existing or improved programs are not enough to address community's commercial solar and solar + storage needs. In this case, community organizations and energy champions may want to encourage co-creation of new programs with the utility. If the utility is amenable to such a conversation, there are several different options by which a utility and one or more of their underserved communities can co-create programs:

1. Engaging in co-creation and shared brainstorming sessions with utilities to collectively design and develop innovative programs that address community needs.
2. In some cases, collaborating with utilities as program delivery or outreach partners for new offerings.

Through shared leadership, inclusive decision-making processes, and a commitment to equity, the actions to support collaboration outlined above can contribute to a more sustainable, resilient, and just energy system that benefits communities and the environment alike.

Conclusion

Underserved communities, particularly BIPOC and LMI communities, face significant energy challenges. As the teams from the Solar Energy Innovation Network demonstrate, collaboration between communities and utilities to enable greater access to solar and solar + storage programs can support increased energy equity for these communities. Such collaborations can help underserved communities access programs that drive energy affordability, outage survivability, and community resilience.

In the rapidly evolving energy landscape, utilities have an array of tools and incentives to work with underrecognized communities to address community needs. Advancements in renewable energy and energy storage, coupled with federal policy incentives, provide opportunities to support communities in making progress on their energy transitions. However, these tools can only be effectively utilized if utilities collaborate effectively with their communities.

The dynamics between utilities and underserved communities can be complex and challenging, with a lot of history. By acknowledging these challenges and actively seeking to take steps to address them, utilities can establish and grow transformative relationships with communities and prioritize their needs. This report specifically covers some ideas of how utilities and under-resourced communities can partner and collaborate in the design and deployment of commercial solar + storage programs. It can serve as a guide to facilitate these discussions and offers examples for potential success for community-led energy transitions.

Appendix A: Benefits and Challenges of Solar and Solar + Storage

This appendix offers a deeper look into the pros and cons of using solar and solar + storage systems for different stakeholders, focusing on the four use cases listed below. For each use case, we describe what it means for different groups: the community, utility companies, and building owners.[xxviii]

1. Solar for Bill Savings
2. Solar + Storage for Bill Savings
3. Solar + Storage Microgrid for Outage Survivability
4. Solar + Storage Microgrid for Community Resilience

Benefits of Solar and Solar + Storage for Bill Savings

The first two use cases, Solar for Bill Savings and Solar + Storage for Bill Savings, primarily aim to offer financial advantages to building owners. Both share similar benefits such as reduced electricity bills, while also presenting similar challenges like up-front costs and maintenance responsibilities. Therefore, we group these two use cases together to better outline their overlapping benefits and challenges.

[xxviii] Section 1 discusses the role of CBOs in the implementation of these programs, but this appendix focuses on the benefits and challenges that the community itself may face because of these programs.

Table 11: Benefits of Solar and Solar + Storage for Bill Savings

	Community	Utility	Building Owner
Solar for Bill Savings	Regional economic development through job creation if a pipeline of projects is created.* Empowers local participation in the community's energy transition, especially if businesses are community owned.†	Compliance with renewable or solar mandates, where applicable, if the utility purchases the RECs. Reduced wholesale energy costs.‡	If the building owner owns the PV, or if a third-party lease or a power purchase agreement (PPA) is used, reduced electricity bills when the PV generates power consumed on site, in most US locations. Where net energy metering or net billing policies exist, potential bill credits from selling excess power to the utility. Substantially reduced upfront cost if a third-party lease or PPA is used. Hedge against future electricity price increases, unless the solar lease or PPA has an escalator tied to electricity rates.§
Solar+ Storage for Bill Savings	All the above.	All the above, plus: With utility policies or rate structures that encourage storage to be discharged in a way that helps the utility grid, enhanced grid management, and stability through storage.** Need to manage grid integration of solar + storage systems, which is generally easier than only solar.†† If the storage is (co-)owned by the utility, the opportunity to take advantage of IRA battery subsidies.	All the above, plus:‡‡ Potential revenue from selling excess power back to the grid at economically optimal times. Enhanced financial benefit from solar PV through increased self-consumption at economically optimal times. Ability to manage bills more effectively where time-varying rates or demand changes are in place.§§

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Notes on Table 11:
** See endnote[43]*
† See endnote[44]
‡ See endnote[45]
§ See endnote[46]
*** See endnote[47]*
†† See endnote[48]
‡‡ Availability and applicability of the benefits listed can vary based on regulatory context and specific utility policies. For example, in many regulatory contexts, such as under net metering, customers may be restricted from both selling excess power back to the grid and optimizing self-consumption simultaneously. Regulations often prevent this to avoid battery arbitrage by the customer. However, there are exceptions; for instance, in Hawaii, both options are available for customers under specific tariffs. It's essential to be aware of local regulations and policies when considering these benefits. [49]
§§ See endnote[50]

Challenges with Solar and Solar + Storage for Bill Savings

Even with the benefits describe above, it's equally important to acknowledge and prepare for potential obstacles. These challenges can include community concerns over costs borne by non-solar customers, potential revenue loss for utilities, and up-front installation costs for building owners if they own the solar or solar + storage.

Table 12: Challenges with Solar and Solar + Storage for Bill Savings

	Community	Utility	Building Owner
Solar for Bill Savings	Potential for grid maintenance and upgrade costs to be disproportionately borne by non-solar customers, if solar compensation rates are too high.*	Potential revenue loss due to reduced electricity sales. Need to manage grid integration of distributed solar.	If the building owner owns the PV, the upfront cost of solar installation. If the building owner owns the PV, the responsibility and/or cost (if contracted out) for system maintenance.
Solar+ Storage for Bill Savings	Same as the above.	All the above, plus: Potential for increased complexity in rate design and compensation mechanisms to value storage dispatch that supports the utility system.† Potential for reduced earnings from capital expenditures when customer owns behind-the-meter systems.‡	All the above, plus: Upfront costs will exceed those for solar alone. Technical complexities of system design to use the battery dispatch to optimize bill credits and/or power sales to the utility are greater with storage. Over time, the need to manage operation of storage system to maximize benefits. Navigating the regulatory environment and utility programs can be more complex with storage.

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Notes on Table 12:
** See endnote[51]*
† See endnote[52]
‡ See endnote[53]

Benefits of Solar + Storage Microgrid for Outage Survivability and Community Resilience

The third and fourth use cases, Solar + Storage Microgrid for Outage Survivability and Solar + Storage Microgrid for Community Resilience, concentrate on improving community resilience and enhancing outage survivability. Given their strong emphasis on ensuring power continuity and improving community resilience, we examine these two cases together, highlighting the common benefits they can bring to communities, utilities, and building owners alike.

Table 13: Benefits of Solar + Storage Microgrid for Outage Survivability and Community Resilience

	Community	Utility	Building Owner
Solar + Storage Microgrid for Outage Survivability	Improved energy security/resilience, albeit only for a limited time and select critical functional services. Continuity of critical functional services during outages	Reduces strain on grid during outages. Facilitates faster outage recovery by reducing demand on the grid.* Enhances overall grid resilience.	Uninterrupted electricity service; avoided costs from interruption of operations during outages. Provides reliable backup power for critical loads and functional services during grid disruptions. Reduced energy bills.
Solar + Storage Microgrid for Community Resilience	All the above, plus: Provides emergency shelters; supports community in times of disaster. Ensures reliable power, charging stations, and communication networks. Creates equitable access to vital resources.	All the above, plus: Opportunity to support financially viable resilience hubs through programmatic assistance.	All the above, plus: Opportunity to support the broader community during power outages. Increased safety from additional services available during emergencies.

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Notes on Table 13:
** See endnote[54]*

Challenges with Solar + Storage Microgrid for Outage Survivability and Community Resilience

While these use cases can offer notable benefits, they come with their own set of challenges. From potential operational complexities for utilities to the need for reliable transportation during outages for communities, these challenges require careful consideration and strategic management to fully unlock the potential of solar + storage microgrid systems.

Table 14: Challenges with Solar + Storage Microgrid for Outage Survivability and Community Resilience

	Community	Utility	Building Owner
Solar + Storage for Outage Survivability	Potential for grid maintenance and upgrade costs to be disproportionately borne by non-solar customer if solar compensation rates are too high.*	Operational complexities in implementing interconnection programs. Potential revenue loss due to reduced electricity sales.	Benefits are limited by the building/asset owners' interest in distributing outage resilience benefits to the community. Operation and maintenance costs.
Solar + Storage for Community Resilience	All the above, plus: Requires reliable transportation in times of natural disasters or during outages.†	All the above.	All the above.

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Notes on Table 14:
** See endnote[55]*
† See endnote[56]

Appendix B: Supportive Utility Offerings

This appendix outlines a range of programs and services that can be directly offered by utilities to support the adoption of commercial solar and solar + storage systems in underserved communities. Not all of them are offered by any one utility, but the range described here is intended to explain the possibilities.

The programs and services that utilities can offer to support the adoption of solar, solar + storage, and solar + storage microgrid systems are categorized as follows: **rebates and grants**, **compensation and rates**, **financing arrangements**, and **technical support and infrastructure**. For each category of utility offerings, this appendix presents a detailed table that includes a description of the offering and how it can support the adoption of these technologies. Such utility offerings, where available, can play a crucial role in ensuring that the benefits of solar and solar + storage are accessible to all communities.

The availability and specifics of utility offerings can vary widely depending on several factors. State legislation and regulation play a significant role in determining what programs and services utilities can offer.[xxix, 57] For example, some states have specific mandates or incentives for renewable energy adoption, while others may have more restrictive regulations. In addition, some states may allow utilities to play a role in behind-the-meter storage leasing or ownership; others may not.

In addition to state-level factors, individual utility goals and strategies also influence the offerings available. A utility's resource planning, grid management strategies, customer engagement efforts, and financial health can all impact the types of programs and services it offers. For instance, utilities with internal corporate strategies for equity or community relations may prioritize addressing energy inequities by expanding access to and tailoring their existing or under-development programs to better meet the needs of underserved communities.[xxx, 58]

Furthermore, local factors such as climate, electricity demand patterns, and the existing energy infrastructure can also influence utility offerings. For example, in regions with high peak electricity demand, utilities might offer more attractive rates or incentives for solar + storage systems that can help manage peak loads, which can be particularly beneficial for low-income communities that are often most affected by high energy costs.

While this appendix provides a general overview of potential utility offerings across the United States, it is important to research the specific programs and services offered by your local utility and

[xxix] State policy plays a critical role in shaping clean energy markets and related deployment opportunities, as detailed in the National Renewable Energy Laboratory's (NREL's) report *Check the Storage Stack: Comparing Behind-the-Meter Energy Storage State Policy Stacks in the United States*. The report highlights the concept of policy sequencing or stacking, where market preparation, creation, and expansion policies are adopted either sequentially or in tandem. This approach can lead to a more effective and cost-efficient policy framework that better achieves policymakers' intended deployment goals.
[xxx] An example is provided by Seattle City Light, which in 2021 developed a Clean Energy Equity Plan to guide the utility's integration of equity into its planning, programs, and projects.

understand the regulatory context in your state.[xxxi, 59] This will provide the most accurate and relevant information for each community's specific situation, and help the reader understand how these offerings can contribute to energy equity in your community.

While third-party arrangements like solar leasing and PPAs can also play a significant role in promoting solar adoption, they are not included here as the focus is on initiatives where utilities have a direct role in providing or facilitating the service.

Rebates and Grants

This category includes all forms of financial assistance that can help reduce the up-front costs of solar and solar + storage systems. This financial assistance can support all four solar and solar + storage use cases.

[xxxi] The Clean Energy States Alliance maintains a directory of state clean energy programs specifically targeted to low- and moderate-income residents and communities. This directory includes programs that focus on various clean energy technologies, including solar, wind, energy storage, and renewable thermal technologies. It serves as a useful resource for understanding the range of strategies states are employing to ensure that these communities can benefit from clean energy technologies.

Table 15: Rebates and Grants

Potential Offerings	Description
Solar Rebates and Grants	Some utilities offer solar rebates or grants to customers who install solar panels.* These incentives reduce the up-front cost of installing a solar system and make solar power more affordable and accessible to a wider range of customers. These funds can come from ratepayer funds assessed on the bills of some or all customers, or other sources. Utility-sourced rebates and grants may not be sufficient for under-resourced or undercapitalized BIPOC businesses. In such scenarios, third-party grants could provide the necessary support. Utilities may assist customers in connecting with these additional funding sources.
Energy Storage Rebates and Grants	Some utilities offer specific rebates or grants for the installation of energy storage systems. Such rebates may be a direct reduction in the cost of the system or may be structured as a discount on leased equipment.† These incentives reduce the up-front cost of the storage system to encourage more building owners to adopt solar + storage solutions. The funds for these incentives can come from ratepayer funds assessed on the bills of some or all customers, or other sources. By reducing the cost of installing energy storage systems, these rebates and grants can make solar + storage solutions more financially viable and attractive to customers.

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Notes on Table 15:
** An example of utilities offering solar rebates and grants can be seen in the "Lower Income Solar Energy Program (LISEP)" by NV Energy and the Nevada Governor's Office of Energy. This program provides incentives for solar PV systems for low-income populations and is funded through the Renewable Energy Account. Qualifying businesses include those serving low-income individuals, such as homeless shelters and food banks, as well as low-income housing units. The program's incentives help reduce up-front costs, making solar more accessible and affordable for these segments of the population.*[60]
† An illustrative example of utilities offering energy storage rebates and grants is the "Bring Your Own Device" program by Green Mountain Power in partnership with Renewable Energy Vermont. This initiative provides significant up-front incentives to customers who purchase home batteries and enroll them to share stored energy with the utility. The program is designed to leverage stored energy from these batteries during energy peak times, reducing strain on the grid and decreasing energy costs for all customers.[61]

Compensation and Rates

Compensation mechanisms and rates offered by utilities play a pivotal role in shaping the financial viability and attractiveness of these systems for customers.

Compensation mechanisms refer to the ways in which system owners are rewarded for the electricity they generate and other services they provide to the grid. Compensation is typically in the form of credits on the customers' utility bill but can also include payments.

Rates, on the other hand, refer to the pricing structures set by utilities for the electricity they sell to customers. These rates can vary based on time of day, level of demand, and other factors. Some utility offerings, such as Buy All, Sell All and Net Billing Programs, combine both compensation mechanisms and rates.

When customers install solar or solar + storage systems, they become both consumers and producers of electricity. Therefore, understanding both compensation mechanisms and rates is crucial, as they directly influence the system's economics. These offerings provide a range of options that utilities can offer to help their customers balance the costs of consumption and the compensation for generation.

All these compensation mechanisms and rates can support two use cases: Solar and Solar + Storage for Bill Savings.

Table 16: Compensation and Rates

Potential Offerings	Description
Net Energy Metering (Compensation)	Net energy metering is a billing arrangement that credits solar and solar + storage system hosts for excess electricity they generate. When the system's production exceeds the building's usage, the excess power is fed into the grid. In most locations this effectively runs the customer's meter backward. Solar generation can be credited at the utility's full retail rate, at the wholesale rate, or sometimes not at all; the specifics depend on the state and utility and must be investigated for any individual building owner. For solar + storage systems, stored energy can be discharged to the grid. The time that is optimal for discharge could be during high demand, during high electricity price times, late afternoon in areas with a lot of solar, or other times as indicated by the utility through their programs; the details will be specific to individual states and utilities. This mechanism helps offset the cost of power drawn from the utility when the system's production is less than demand, making it a key financial incentive that can improve the economics of installing a solar or solar + storage system.
Renewable Energy Certificate Purchasing (Compensation)	Renewable energy certificates (RECs) purchasing is a mechanism in which utilities purchase RECs from solar system owners.* RECs represent the environmental benefits of renewable energy generation. Utilities often purchase RECs to meet regulatory requirements or voluntary renewable energy targets; RECs that are used to meet mandates cannot also be used to support voluntary customer programs. When system owners sell RECs to utilities, it provides an additional revenue stream on bills for solar system owners, helping to offset the costs of installing and maintaining the system and thereby making solar power more affordable. However, after the sales of RECs, the system owner can no longer claim that their building is powered by solar or renewable power.† One option used in the federal sector is to buy replacement RECs, so that renewable power claims can still be legally made.‡
Demand Response Programs (Compensation)	Demand response programs incentivize customers to reduce or shift their electricity usage during times of peak demand. Customers with energy storage can take advantage of demand response programs by discharging their stored energy during peak times, effectively reducing their net electricity usage. Utilities often prefer to have control over the operation of the devices to give them visibility and enable them to optimize grid performance. Utilities may offer additional compensation or reduced technology costs to customers who allow them this control — which could include air conditioners, hot water heaters, or storage. In addition, utilities may prefer ownership or leasing structures, where they can earn a return on the rate base associated with leased technologies on customer sites.§ In some cases, demand response programs might include provisions for grid services (defined below). Demand response programs can not only lower customer electricity bills but also help utilities manage the load on the grid, reducing the need for expensive and polluting peaker plants.**
Grid Services (Compensation)	Grid services are services that utility customers' energy resources can provide to help maintain the reliability and stability of the electrical grid, including ancillary services such as frequency response and voltage regulation. solar + storage systems can provide these services by adjusting their power output in response to signals from the grid operator. This includes maintaining the proper flow and direction of electricity, addressing imbalances between supply and demand, and helping the system recover after a power system event. Solar systems, particularly those equipped with advanced inverters, can also contribute to these services to some extent, but their ability to do so is more limited compared to solar + storage systems. In some cases, demand response programs (as described above) might include provisions for these types of grid services. Utilities may offer compensation to customers who provide these services, recognizing the value they provide to the grid.††
Virtual Power Plants (Compensation)	Virtual power plants (VPPs) are networks of distributed energy resources, such as solar panels and energy storage systems, that are coordinated to provide power and grid services.‡‡ VPPs can be used to aggregate the capacity of individual systems and use it to provide power during times of high demand or when other power sources are unavailable.§§ VPPs can help to improve grid reliability and reduce the need for traditional power plants. Utilities may facilitate the creation of VPPs by providing technical support and compensation mechanisms for customers who participate in them.

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Table 16: Compensation and Rates, continued

Potential Offerings	Description
Buy All, Sell All Programs and Net Billing Programs (Compensation + Rate)	Buy all, sell all programs and net billing programs involve both a compensation mechanism, where the utility compensates the customer for the electricity produced by the solar or solar + storage system and sold to the grid, and a rate at which the customer purchases electricity from the utility. In these programs customers interact with the grid differently. In buy all, sell all programs, customers sell all their solar system's electricity production to the grid at a predetermined rate, and buy electricity for their own needs at a different rate. Conversely, net billing programs allow customers to first consume the electricity they generate, selling only the excess production to the grid, thus primarily serving their own electricity needs. The financial viability for system owners in both these programs depends on the sell rates (i.e., the compensation) set for power exported to the grid. The sell rate could take various forms, such as a value of solar tariff (see below) or others, depending on the specific program and local regulations.
Value of Solar Tariffs (Compensation)	Value of solar tariffs (VOSTs) are a customer compensation mechanism used within buy all, sell all and net billing programs that attempt to accurately value the electricity produced by solar systems, considering factors like environmental benefits and grid support. VOSTs are also used in other programs where there is a need to determine a fair and accurate price for solar energy that reflects its true value to the grid and society.*** The financial viability for system owners depends on the sell rates set for power exported to the grid. This may include the value of avoided power generation, avoided capacity, avoided greenhouse gas emissions, resilience, reliability benefits, and more. VOSTs can make solar power more affordable when factors like environmental benefits and grid support are considered.†††
Time-of-Use Rates (Rate)	Time-of-use (TOU) rates are a basic form of time-based electricity pricing.‡‡‡ These rates use predetermined electricity prices that vary at different times of the day and/or seasonally, with higher rates during peak demand periods and lower rates during off-peak periods. This base structure can be further modified to increase sophistication without needing a more complex rate design.**** For instance, modifications could include the introduction of dynamic pricing, where rates are adjusted in real-time based on actual system conditions, or critical peak pricing (defined below), where rates significantly increase during periods of highest demand. For customers with solar + storage systems, TOU rates can lead to savings as these systems can generate and store power when rates are low, and then use or sell this power when rates are high. However, for solar-only customers, the benefits of TOU rates are contingent on the alignment between their system's power generation and the TOU rate structure. For instance, savings could be realized if the system generates power during on-peak hours, or a mix of on-peak, off-peak, and shoulder hours. Additionally, automation can further enhance the benefits of TOU rates. Utilities can support this by offering tools such as smart thermostats to customers, enabling them to automatically adjust their energy usage in response to changing rates, thereby maximizing their savings.
Critical Peak Pricing (Rate)	Critical peak pricing (CPP) is a sophisticated rate modification that can be added to different base structures, such as time-of-use rates.†††† CPP is a dynamic rate structure that charges significantly higher rates during occasional periods of extremely high demand, known as critical peak periods. These peak events are typically forecasted a few hours to a day in advance, and customers are notified accordingly. For customers with solar or solar + storage systems, CPP can provide savings opportunities. During high-cost periods, customers are incentivized to use their own generated power, thereby reducing their reliance on the grid. This not only leads to savings on their energy bills but also contributes to grid stability by reducing peak demand. Furthermore, customers with energy storage can store solar power generated during off-peak hours for use during these high-cost periods, further maximizing their savings and enhancing the value of their solar + storage system.
Lowered Standby Rates (Rate)	Standby rates are fees charged by utilities to customers who generate their own electricity but remain connected to the grid for backup power or to sell excess generation.‡‡‡‡ These rates are necessary as they help cover the costs of maintaining the grid infrastructure that these customers rely on for backup power and selling excess generation. However, high standby rates can make solar or solar + storage systems less financially viable. Therefore, reducing these rates, while ensuring that the costs of grid maintenance are covered, can improve the economics of these systems. It's important for customers to understand their applicable standby rates, as these can significantly impact the overall cost-effectiveness of their system.
Lowered Fixed Charges (Rate)	Fixed charges are applied to customers who generate their own electricity, such as those with solar or solar + storage systems. These charges help cover the fixed costs of providing electric service, such as metering, billing, and customer service. High fixed charges can discourage the deployment of these systems, as they can significantly impact the overall cost-effectiveness of the system. Lower fixed charges, that still cover the necessary fixed costs, can make solar and solar + storage systems more financially viable and encourage their adoption. It's important for customers to understand their applicable fixed charges, as these can significantly impact the overall cost-effectiveness of their system. Utilities can support this understanding by providing clear and transparent information about these charges.

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Notes on Table 16:

** The US Environmental Protection Agency defines a renewable energy certificate, or REC, as a "market-based instrument that represents the property rights to the environmental, social, and other non-power attributes of renewable electricity generation. RECs are issued when one megawatt-hour (MWh) of electricity is generated and delivered to the electricity grid from a renewable energy resource." A REC, and its associated attributes and benefits, can be sold separately from the underlying physical electricity associated with a renewable-based generation source.*[62]

† See endnote.[63]

‡ See endnote.[64]

§ "Earn a return on the rate base" refers to the regulated profit that utilities are allowed to make on their investments in infrastructure, such as power plants, transmission lines, and, in this case, leased technologies on customer sites. The rate base is the value of all the utility's capital assets. Regulators set a rate of return that utilities are allowed to earn on this rate base to ensure they can cover their costs and make a reasonable profit. This mechanism is a fundamental part of the traditional utility business model.[65]

*** See endnote.*[66]

†† See endnote.[67]

‡‡ While VPPs hold the potential to support underserved communities by providing more equitable access to energy and grid services, it is important to note that, as of this writing, we have not identified specific examples where VPPs have been directly implemented to benefit such communities. Further research and exploration in this area may yield more insights into the direct impact of VPPs on underserved populations.

§§ See endnote.[68]

**** See endnote.*[69]

††† Minnesota's implementation of the value of solar tariff (VOST) policy serves as an example of how to accurately value the electricity produced by solar systems. The policy considers factors such as avoided energy costs, reduced need for additional power plant capacity, and grid benefits, providing a 25-year contract at a fixed price.[70]

‡‡‡ See endnote.[71],[72]

***** See endnote.*[73]

†††† See endnote.[74]

‡‡‡‡ See endnote.[75]

Financing Arrangements

This category refers to financial mechanisms that utilities can offer to help customers manage the up-front costs of installing solar and solar + storage systems.

On-bill financing can support all four solar and solar + storage use cases. Energy storage leasing applies to the use cases involving energy storage. Land-lease compensation and utility-owned solar help to make solar and solar + storage systems more financially accessible, but they don't directly contribute to the goals of outage survivability and community resilience.

Table 17: Financing Arrangements

Potential Offerings	Description
On-Bill Financing for Solar or Solar + Storage	On-bill financing allows customers to pay for their solar and energy storage installations through their utility bill.* The utility incurs the upfront cost of the solar or solar + storage upgrades, and the customer repays this investment through a charge on their monthly utility bill. This arrangement is particularly beneficial as utilities already have a billing relationship with their customers, as well as access to information about their energy usage patterns and payment history. In some on-bill financing programs, the loan is transferable to the next owner of the home or building. These programs allow customers to finance their solar and energy storage systems through their utility bill, making the cost more manageable by spreading it over time.†
Land-Lease Compensation	Land-lease compensation is a financial arrangement where utilities or solar developers pay customers to lease their land or roof space for the installation of solar or solar + storage systems.‡ Lease rates can vary widely depending on factors such as the location and size of the land or rooftop space. This arrangement can provide a steady income stream for the landowner, turning unused or underused land and rooftop space into a revenue generation opportunity.
Utility-Owned Solar	In utility-owned solar arrangements, the utility owns and maintains the solar system installed on a customer's property.§ The customer typically pays a fee to the utility for the power produced by the system, which can be structured in various ways, such as a fixed monthly fee or a fee based on the amount of solar power produced. This arrangement allows customers to benefit from solar power without the need for a large upfront investment or the responsibility of maintaining the system. It also allows the utility to increase its renewable energy capacity and potentially offer lower rates to the customer than traditional electricity rates.
Energy Storage Leasing	Energy storage leasing is a financial arrangement where a third party or the utility owns and maintains an energy storage system installed on a customer's property. The customer pays a monthly lease fee for the use of the system.** This arrangement allows customers to benefit from the advantages of energy storage, such as improved energy resilience and potential cost savings from demand charge reduction or time-of-use pricing, without the need for a large upfront investment. While demand charges can apply to both small businesses and large commercial consumers, the impact can be more significant for larger commercial customers due to their typically higher peaks in electricity usage. However, small businesses with high power equipment may also find an energy storage lease to be beneficial. Therefore, it is recommended that communities consult with customers to understand their unique electricity usage patterns and potential exposure to demand charges.

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Notes on Table 17:
** See endnote.*[76]
† Holy Cross Energy, a rural electric cooperative in Colorado, launched an on-bill tariff pilot program aimed at financing battery energy storage systems for its members. The program, known as Power+, involves six homes that will each receive two or three Tesla Powerwall lithium-ion battery packs. Participants repay Holy Cross Energy over 10 years through a line item on their utility bills, covering the costs of the Tesla batteries. [77]
‡ See endnote.[78]
§ See endnote.[79]
*** See endnote.*[80]

Technical Support and Infrastructure

This category covers the technical support and infrastructure services that utilities may provide to facilitate the integration of solar and solar + storage systems into the grid. Utilities can offer a variety of technical support and infrastructure services to aid the integration of solar and solar + storage systems into the grid, although few offer all these services, and some do not offer any of them.

These services, delivered through online resources, call centers, in-person consultations, and dedicated account management, cover system design guidance, regulatory navigation, installation support, maintenance, troubleshooting, and grid interconnection assistance. The specific form of these services often depends on the utility and the customer's specific needs.

These technical support and infrastructure offerings can support all four solar and solar + storage use cases. The only exception is resilience planning support, which is specific to outage survivability and community resilience.

Although utilities have provided these types of services for other technologies, and there's been engagement with SEIN Round 3 teams on similar tasks, we don't have concrete examples to cite when it comes to solar or solar + storage in under-resourced communities. Therefore, we present these offerings as inspiration for utilities aiming to better meet the needs of these communities.

Table 18: Technical Support and Infrastructure

Potential Offerings	Description
System Design Guidance	Utilities can provide advice on the optimal design of solar, solar + storage, and solar + storage microgrid systems to maximize energy production, bill savings, and resilience. This can include advice on the best location for the system, the optimal tilt and orientation of the solar panels, the appropriate size of the system based on the customer's energy usage patterns, and guidance on how to manage and balance loads within a microgrid for optimal resilience.
Installation Support	Utilities can provide technical support during the installation process to ensure that the system is installed correctly and safely. This can include providing a list of approved installers, offering training programs for installers, and conducting inspections of the system.
Regulatory Navigation	Utilities can assist customers in navigating the regulatory landscape for solar and solar + storage systems. This can include providing information on relevant local and national regulations, assisting with the application process for permits and approvals, and providing guidance on compliance with grid interconnection standards.
Maintenance and Troubleshooting	Tariffs for on-bill financing, utility-owned or utility-leased solar, or storage offerings should either designate the utility, the customer, or another entity as responsible for providing ongoing maintenance and operations service. This can include providing troubleshooting assistance in case of technical issues, offering advice on system maintenance, and providing information on how to monitor and optimize system performance. For microgrids, this can also include guidance on how to operate the microgrid in both grid-connected and islanded modes.
Grid Interconnection Assistance	Utilities can assist customers with the process of connecting their solar or solar + storage system to the grid. This can include providing information on the interconnection process, assisting with the application for interconnection, and conducting the necessary inspections and tests to ensure that the system is safely connected to the grid.
Resilience Planning	Utilities can assist in identifying critical loads and planning for how the microgrid will support these loads during an outage. This could include helping to develop emergency response plans and resilience strategies.

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Appendix C: Available Federal Financing Opportunities

This appendix is intended to support readers with an understanding of the federal financing opportunities enabled by the Inflation Reduction Act that are most critical for supporting commercial solar and solar + storage microgrid projects. Table 19 outlines the Investment Tax Credit updates, which can support up to 70% of a solar project's costs when project developers invest in community and economic development, as outlined below.

Table 19: Notable Investment Tax Credit (ITC) provisions for Commercial Solar + Storage Projects, Expanded

ITC Provisions	Description
Energy Communities Adder	A 10% bonus tax credit awarded to solar owners who site their projects in an "energy community" that is located: 1. At a brownfield site.* 2. In a "statistical area" with either more than 0.17% fossil fuel employment or 25% tax revenue from fossil fuels. 3. At a "coal closure category" with a closed coal mine since 2000 or a coal power plant retirement since 2010.
Domestic Content Adder	A 10% bonus tax credit awarded to solar owners who acquire their materials from the United States, specifically: 1. All structural steel and iron. 2. 40% of all manufactured products that are 100% US-made or deemed to be US-made for 2023–2024 projects. Note: While this adder can create economic benefits, those benefits may not necessarily be allocated to the local community based on this adder, as this can be acquired across the United States. See the "Prevailing Wage and Apprenticeship Requirements" content below for local workforce impacts.
Low Income Adder	A 10% bonus tax credit awarded to solar projects under 5 MW that are: 1. Located in low-income communities. 2. Located on tribal lands. Alternatively, a 20% adder for projects that are: 1. Located on qualified low-income residential buildings. 2. Supply qualified benefits directly to the low-income communities.
Prevailing Wage and Apprenticeship Requirements†	To qualify for the base (30%) tax credit, all projects over 1MW must meet Prevailing Wage and Apprenticeship requirements, including:‡ 1. All laborers, mechanics, contractors, and subcontracts must be paid at prevailing rates during the construction of the project and during alterations and repairs for the next five years, and 2. A percent of total labor hours for construction, alteration or repair work on the project must be performed by qualified apprentices (12.5% in 2023 and 15% beginning in 2024.)

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Notes on Table 19:
** A brownfield is property damaged by a pollutant or contaminant, eligible for expansion, redevelopment, or reuse.*[81]
† A prevailing wage is the minimum hourly wage, including fringe benefits, paid to workers in a specific geographic area for a particular type of work as determined by the US Department of Labor or state labor agencies. It ensures that workers on government-funded construction projects are paid fairly and at a rate comparable to local standards in their respective industries. The SEIN Round 3 team Solar for Safety & Success (3S) is developing a solar jobs training program with Golden Triangle Empowerment Center that could serve as an example for organizations looking into developing local workforce trainings to comply with this requirement.[82]
‡ See endnote.[83]

Appendix D: Non-Technical Glossary

Disclaimer: This glossary covers non-technical terms and acronyms used throughout this report. For definitions of technical terms, please refer to *Appendix E: Technical Glossary*. As you read the report, specific terms may also be explained in footnotes where necessary.

BIPOC: Black, Indigenous, and People of Color.

CBO: Community-based organization. A group that operates at the local level, dedicated to serving the needs and interests of a specific community or geographic area. CBOs are typically grassroots organizations that may be nonprofit, community-driven, or established as social enterprises. They often have a deep understanding of the unique challenges and aspirations of the community they serve and work closely with residents, local businesses, and other stakeholders to address various social, economic, and environmental issues. CBOs can play a vital role in advocating for and supporting the adoption of renewable energy solutions within the community. They do so by raising awareness about the benefits of solar power and energy storage, engaging with building owners and utilities to foster partnerships, and driving the development of community-driven clean energy projects. CBOs can serve as a catalyst for change, facilitating collaboration between stakeholders and helping to overcome barriers to adoption.

Community: A group of individuals, organizations, and stakeholders who reside, work, or have a vested interest in a particular area or locality. This includes residents, local businesses, community-based organizations, and public institutions. In the context of this report, when we refer to a "community," we are particularly interested in underserved communities, referring to populations or areas that have historically had less access to resources and services, such as quality healthcare, education, and clean energy technologies. This can include low-income communities, communities of color, rural areas, and other under-resourced groups. These communities often face higher energy burdens, meaning they spend a larger proportion of their income on energy costs. They may also face additional barriers to accessing clean energy solutions, such as lack of information, up-front costs, or housing status.

IRA: Inflation Reduction Act.

LMI: Low to Moderate Income.

SEIN: Solar Energy Innovation Network facilitates peer-to-peer learning with other teams working toward solar solutions. SEIN is funded by the US Department of Energy Solar Energy Technologies Office and is led by the National Renewable Energy Laboratory. All eight SEIN projects from 2022 to 2023, called Round 3, worked on solutions to support the equitable deployment of solar in underserved communities.

These technologies/These programs: Refer to all use cases for commercial solar and solar + storage microgrids explored in the Section 1 use cases.

Appendix E: Technical Glossary

Disclaimer: This glossary covers technical terms used throughout this report. For definitions of non-technical terms, please refer to *Appendix D: Non-Technical Glossary*. As you read the report, specific terms may also be explained in footnotes where necessary.

Bill Savings: The reduction in cost on a customer's energy bill, which could be achieved through energy efficiency measures, use of renewable energy, demand response programs, or other means.

Buy All, Sell All Programs: Defined in *Appendix B: Supportive Utility Offerings* under "Compensation and Rates."

Commercial-Scale Solar: For the purposes of this report, this refers to solar power installations installed on commercial business buildings rather than individual homes.

Compensation Mechanism: A system or structure through which the utility pays the customer in return for services or resources provided, such as supplying electricity back to the grid from a home solar power system.

Critical Peak Pricing: Defined in *Appendix B: Supportive Utility Offerings* under "Compensation and Rates."

Critical Services: Services that are deemed essential for the functioning of a community or society. This may include utilities like electricity, water, healthcare services, and emergency response services.

Customer-Controlled Assets: Assets owned and controlled by a utility's customers. In an energy context, this might include solar panels, batteries, and electric vehicles that can contribute to the grid if part of a distributed energy resources system.

Demand Response Programs: Demand response programs incentivize customers to reduce or shift their electricity usage during times of peak demand. Customers with energy storage can take advantage of demand response programs by discharging their stored energy during peak times, effectively reducing their net electricity usage. Described more in detail in *Appendix B: Supportive Utility Offerings* under "Compensation and Rates."

Dispatchable Power: This refers to sources of electricity that can be turned on or off, or scaled up or down, according to demand. Dispatchable power sources are key to balancing supply and demand on the electricity grid.

Energy Efficiency: The practice of using less energy to perform the same task or achieve the same outcome.

Grants: Financial awards given by government departments, corporations, foundations, etc., typically for a specific purpose, such as installing renewable energy systems. Grants do not have to be repaid.

Grid: This refers to the electricity grid, the network of transmission and distribution lines, substations, and transformers that deliver electricity from power plants to homes, businesses, and other electricity users.

Grid Congestion: A situation where the demand for electricity exceeds the capacity of the grid to deliver it, which can cause blackouts or brownouts.

Grid Reliability: The ability of the electricity grid to provide a constant, uninterrupted supply of electricity.

Grid Services: Grid services are services that utility customers' energy resources can provide to help maintain the reliability and stability of the electrical grid, including ancillary services such as frequency response and voltage regulation. Described more in detail in *Appendix B: Supportive Utility Offerings* under "Compensation and Rates."

Islanding: The ability of an energy asset to disconnect from the main grid and continue operating independently. This can be crucial during power outages or grid instability.

Land-Lease Compensation: Defined in *Appendix B: Supportive Utility Offerings* under "Financing Arrangements."

Load Management/Grid Stability: The process of balancing supply and demand on the electricity grid to ensure it remains stable and operates at a constant frequency.

Lowered Fixed Charges: Defined in *Appendix B: Supportive Utility Offerings* under "Compensation and Rates."

Lowered Standby Rates: Defined in *Appendix B: Supportive Utility Offerings* under "Compensation and Rates."

Microgrid: Microgrid technology refers to a localized group of electricity sources and loads that can function independently from the traditional, centralized electrical grid (i.e., ability to island). Microgrids can operate while connected to the main electrical grid during normal conditions but can also disconnect and operate autonomously using local energy generation in times of crisis, such as during power outages or significant price spikes. This technology enhances energy resilience and reliability, especially in cases of extreme weather events or other disruptions.

Net Billing Programs: Defined in *Appendix B: Supportive Utility Offerings* under "Compensation and Rates."

Net Energy Metering: Net energy metering is a billing arrangement that credits solar and solar + storage system hosts for excess electricity they generate. Described more in detail in *Appendix B: Supportive Utility Offerings* under "Compensation and Rates."

Peak Demand: The highest level of energy consumption within a particular period. Utilities must have enough capacity to meet these peaks to ensure reliable service.

Power Outage Survivability: The ability for a system, like a microgrid or backup generator, to continue providing electricity when there is a power outage in the main grid.

Rates: The prices set by a utility for the provision of services such as electricity or gas. Rates can vary based on time of use, quantity used, and other factors.

Rebates: A form of incentive where a portion of the cost of a particular product or service, such as a solar panel system, is refunded to the customer after purchase.

REC (Renewable Energy Certificate) Purchasing: Renewable energy certificates (RECs) purchasing is a mechanism in which utilities purchase RECs from solar system owners. RECs represent the environmental benefits of renewable energy generation. Described more in detail in *Appendix B: Supportive Utility Offerings* under "Compensation and Rates."

Regulatory Compliance: Adherence to laws, regulations, guidelines, and specifications relevant to a business or activity. In the context of energy, this could include regulations around safety, emissions, and renewable energy targets.

Resilience: In the context of energy, resilience refers to the ability of an energy system to recover quickly from and/or maintain function during severe disruptions, such as extreme weather events or power outages.

Resilience Hubs: Buildings equipped with resilient energy systems, like microgrids or backup generators, that can provide critical community services and support during and after a disruption, such as a major power outage.

System Interconnection: The process of linking a small-scale energy generator, like a rooftop solar panel system, to the larger electricity grid. Interconnection regulations and procedures vary by location and utility.

Tariffs: The pricing structures set by utilities for delivering services such as electricity or gas. They can vary based on usage amount, time of use, and customer type.

Tax Credits: Financial incentives that reduce the amount of tax owed. In the context of energy, tax credits may be offered for things like installing solar panels or energy-efficient appliances.

Time-of-Use Rates: Defined in *Appendix B: Supportive Utility Offerings* under "Compensation and Rates."

Up-front Cost: The initial cost of a product or service before any ongoing costs like maintenance or operation. For energy systems like solar panels or batteries, the up-front cost includes the cost of the equipment and installation.

Utility-Owned Solar: Defined in *Appendix B: Supportive Utility Offerings* under "Financing Arrangements."

Virtual Power Plants: Virtual power plants (VPPs) are networks of distributed energy resources, such as solar panels and energy storage systems, that are coordinated to provide power and grid services. Described more in detail in *Appendix B: Supportive Utility Offerings* under "Compensation and Rates."

Weatherization: The practice of protecting a home or building against weather elements to improve energy efficiency. This can include sealing air leaks, adding insulation, and improving heating and cooling systems.

Wholesale Energy Costs: The price of energy when sold in large quantities, usually from producers to utilities or large industrial customers. This price is usually lower than the retail price paid by end users.

Endnotes

[1] "Home - Solar Energy Innovation Network," National Renewable Energy Laboratory, accessed September 27, 2023. https://www.nrel.gov/solar/market-research-analysis/solar-energy-innovation-network.html.
[2] Lewis, Jamal, Diana Hernández, and Arline T. Geronimus, "Energy Efficiency as Energy Justice: Addressing Racial Inequities through Investments in People and Places," *Energy Efficiency* 13, no. 3 (March 2019): 419–32. https://doi.org/10.1007/s12053-019-09820-z.
[3] Drehobl, Ariel, Lauren Ross, and Roxana Ayala, "How High Are Household Energy Burdens? An Assessment of National and Metropolitan Energy Burden Across the United States," American Council for an Energy-Efficient Economy, September 2020.
[4] "Texas Blackouts Hit Minority Neighborhoods Especially Hard," *The New York Times*. February 16, 2021, https://www.nytimes.com/2021/02/16/climate/texas-blackout-storm-minorities.html; and Foster, Joanna. "Too Many Blackouts: How Underserved Communities Are Making Utilities Listen," EDF Vital Signs. November 28, 2022, https://vitalsigns.edf.org/story/too-many-blackouts-how-underserved-communities-are-making-utilities-listen.
[5] Murphy, Caitlin, Eliza Hotchkiss, Kate Anderson, Clayton Barrows, Stuart Cohen, Sourabh Dalvi, Nick Laws, Jeff Maguire, Gord Stephen, and Eric Wilson, 2020. *Adapting Existing Energy Planning, Simulation, and Operational Models for Resilience Analysis*, National Renewable Energy Laboratory, 2020, https://www.nrel.gov/docs/fy20osti/74241.pdf.
[6] Duke Energy, "Commercial Solar Financing: Leasing Your System vs. Owning It," *Sustainable Solutions*, accessed September 25, 2023. https://sustainablesolutions.duke-energy.com/resources/commercial-solar-financing-leasing-your-system-vs-owning-it/.
[7] Pickerel, Kelly, "2022 UPDATE: Which states offer net metering?" *Solar Power World*, March 27, 2020. Updated in April 2022, https://www.solarpowerworldonline.com/2020/03/which-states-offer-net-metering/.
[8] Kim, June, "Increasing Power Outages Don't Hit Everyone Equally," *Scientific American*, July 26, 2023, https://www.scientificamerican.com/article/increasing-power-outages-dont-hit-everyone-equally1/.
[9] Solar Energy Technologies Office, "Solar Integration: Solar Energy and Storage Basics," National Renewable Energy Laboratory, accessed on September 27, 2023, https://www.energy.gov/eere/solar/solar-integration-solar-energy-and-storage-basics.
[10] "Resilience Hubs: Shifting Power to Communities and Increasing Community Capacity," Urban Sustainability Directors Network, accessed November 6, 2023, https://www.usdn.org/resilience-hubs.html.
[11] Rogerson, Bethany, and Mimi Majumdar Narayan, Ph.D., "Resilience Hubs Can Help Communities Thrive—and Better Weather Disasters," Health Impact Project, June 22, 2020, https://www.pewtrusts.org/en/research-and-analysis/articles/2020/06/22/resilience-hubs-can-help-communities-thrive-and-better-weather-disasters.
[12] Ciriaco, Thayanne G.M., and Stephen D. Wong, "Review of Resilience Hubs and Associated Transportation Needs," Transportation Research Interdisciplinary Perspectives 16: 100697, 2022, https://doi.org/10.1016/j.trip.2022.100697.
[13] Fekete, Emily, Laura Beshilas, Abigail Randall, David Feldman, Jarett Zuboy, and Kristen Ardani, *Solar Power in Your Community*, US Department of Energy (DOE) Solar Energy Technologies Office (SETO), 2023, accessed October 16, 2023, https://www.energy.gov/eere/solar/local-government-guide-solar-deployment.

[14] "Rural- and Commercial-Scale Solar: Solar Energy Innovation Network Round 2," National Renewable Energy Laboratory, accessed November 6, 2023, https://www.nrel.gov/solar/market-research-analysis/solar-energy-innovation-network-round-2.html.
[15] "Breaking Barriers: A Resilience Hub Serving the AUCC, Atlanta GA," Groundswell, accessed November 6, 2023, https://groundswell.org/breaking-barriers-a-resilience-hub-serving-the-aucc-atlanta-ga/.
[16] Environment & Health Data Portal, "How Power Outages Affect Health," January 10, 2022, https://a816-dohbesp.nyc.gov/IndicatorPublic/beta/data-stories/poweroutages/.
[17] Berberian, Alique G., David J. X. Gonzalez, and Lara J. Cushing, "Racial Disparities in Climate Change-Related Health Effects in the United States," *Current Environmental Health Reports* 9, no. 3 (2022): 451–64, https://doi.org/10.1007/s40572-022-00360-w.
[18] "Solar Photovoltaic Installers : Occupational Outlook Handbook: U.S. Bureau of Labor Statistics," accessed November 9, 2023, https://www.bls.gov/ooh/construction-and-extraction/solar-photovoltaic-installers.htm.
[19] University of Wisconsin-Madison Law School, "About Restorative Justice | University of Wisconsin Law School," accessed November 9, 2023, https://law.wisc.edu/fjr/rjp/justice.html.
[20] Billimoria, Sherri, Coreina Chan, Mike Henchen, and Lauren Shwisberg.
Finding Value in the Energy Future: How Utilities Can Collaborate with Low and Moderate-Income Customers to Do More, RMI, 2018, https://info.rmi.org/finding_value_in_energy_future_2018
[21] Kramer, Alexandra, Scott Belding, and Kamyria Coney, *Community Resilience Options: A Menu for Enhancing Local Energy Resilience*, National Renewable Energy Laboratory, https://www.nrel.gov/docs/fy23osti/84493.pdf.
[22] "Community Projects: Solar for Safety and Success," THRIVE, accessed 9 Nov. 2023. https://www.thriveinpatx.org/community-projects/solar-for-safety-and-success.
[23] Ibid.
[24] "Commercial Rooftop Solar: Common Technical Concerns," Colite Technologies, accessed November 9, 2023, https://colitetech.com/blog/commercial-rooftop-solar-common-technical-concerns/.
[25] Bolon, Cecelia, Talia Lanckton, and Shalanda Baker, "Utilities 101: A Guide to the Basics of the Electric Utility Industry with a Focus on Justice," 2020, Initiative for Energy Justice, https://iejusa.org/wp-content/uploads/2020/08/Utilities-101-Full-Guide-v3.pdf.
[26] Bolon, Cecelia, Talia Lanckton, and Shalanda Baker, "Utilities 101: A Guide to the Basics of the Electric Utility Industry with a Focus on Justice," 2020, Initiative for Energy Justice, https://iejusa.org/wp-content/uploads/2020/08/Utilities-101-Full-Guide-v3.pdf.
[27] National Governors Association, "Electricity Markets – 101," accessed November 9, 2023, https://www.nga.org/electricity-markets/.
[28] Wilson, Gennelle, Cory Felder, and Rachel Gold, "States Move Swiftly on Performance-Based Regulation to Achieve Policy Priorities," RMI, March 31, 2022, https://rmi.org/states-move-swiftly-on-performance-based-regulation-to-achieve-policy-priorities/.
[29] "Webinar: Empowering Communities with Solar: How to Leverage IRA Opportunities At Scale," YouTube, uploaded by RMI, 21 June 2023, https://www.youtube.com/watch?v=UMeof8qRmdk.
[30] Bourg-Meyer, Vero, "The Low-Income Communities Bonus Energy Investment Credit Program: Answers to Frequently Asked Questions (FAQs)," Clean Energy States Alliance, June 2023, https://www.cesa.org/wp-content/uploads/Low-Income-Communities-Bonus-Energy-Investment-Credit-Program-FAQs.pdf.

[31] Energy.gov, “Federal Solar Tax Credits for Businesses,” accessed October 12, 2023. https://www.energy.gov/eere/solar/federal-solar-tax-credits-businesses.
[32] “Evaluation, Measurement, and Verification (EM&V) | ACEEE,” accessed October 25, 2023, https://www.aceee.org/topic/emv.
[33] "State Approaches to Intervenor Compensation,” National Association of Regulatory Utility Commissioners (NARUC), December 2021, accessed 9 Nov. 2023, https://pubs.naruc.org/pub/B0D6B1D8-1866-DAAC-99FB-0923FA35ED1E.
[34] "Washington's Clean Energy Future,” Avista, accessed 9 Nov. 2023, https://www.myavista.com/about-us/washingtons-clean-energy-future; "Pacificorp's Approach to the Washington Clean Energy Transformation Act Equity,” Pacificorp, accessed 9 Nov. 2023, https://www.pacificorp.com/energy/washington-clean-energy-transformation-act-equity.html; and "PSE Forms Equity Advisory Group as It Develops Its Clean Energy Implementation Plan,” Puget Sound Energy, June 2021, https://www.pse.com/en/press-release/details/PSE-forms-Equity-Advisory-Group-as-it-develops-its-Clean-Energy-Implementation-Plan.
[35] "E-Lab: Electricity Innovation Lab,” RMI, accessed 9 Nov. 2023, https://rmi.org/our-work/electricity/elab-electricity-innovation-lab/.
[36] "Colorado Public Utilities Commission Invites the Public to Comment on Ways Its Regulation of Utilities Can be More Equitable and Address Historical Inequalities,” Colorado Department of Regulatory Agencies, May 2022, https://dora.colorado.gov/press-release/colorado-public-utilities-commission-puc-invites-the-public-to-comment-on-ways-its; and "Energy Equity and Justice (Docket No. 2022-0250),” Public Utilities Commission, State of Hawaii, accessed 9 Nov. 2023, https://puc.hawaii.gov/energy/equity/.
[37] "Distribution System Planning,” Portland General Electric, accessed 9 Nov. 2023, https://portlandgeneral.com/about/who-we-are/resource-planning/distribution-system-planning.
[38] Allen, Katie, “PG&E Encouraging Eligible Customers To Sign Up for Monthly Energy Discount Program,” PG&E Currents, June 1, 2022, https://www.pgecurrents.com/articles/3464-pg-e-encouraging-eligible-customers-sign-monthly-energy-discount-program.
[39] "Energy-Saving Programs,” PG&E, accessed 9 Nov. 2023, https://www.pge.com/en/save-energy-and-money/energy-saving-programs.html.
[40] Allen, Katie, “PG&E Encouraging Eligible Customers To Sign Up for Monthly Energy Discount Program,” PG&E Currents, June 1, 2022, https://www.pgecurrents.com/articles/3464-pg-e-encouraging-eligible-customers-sign-monthly-energy-discount-program.
[41] Wimberly, Jamie, “5 Questions Utilities Should Consider at the Intersection of Energy Affordability and Equity,” June 27, 2023, https://www.esource.com/blog/446232rduz/5-questions-utilities-should-consider-intersection-energy-affordability-and-equity?utm_source=esource&utm_medium=alert&utm_term=2023-06-30-weekly-alerts&utm_campaign=topical-alerts&mkt_tok=OTIyLVRYUS0xNzEAAAGMq58Rg1OFe-fsuClwU02wI8bMtpnHvpXKcG4N4BUbjUMczulZxPjAosCM975h44y9wphvXPprzIAUV3zpGClE-TaSTuftXKLeY5EtwOnXDUE.
[42] Landry, Lauren, “What Is Human-Centered Design? | HBS Online,” Business Insights Blog, December 15, 2020, https://online.hbs.edu/blog/post/what-is-human-centered-design.
[43] Heath, Garvin, Dwarakanath Ravikumar, Silvana Ovaitt, Leroy Walston, Taylor Curtis, Dev Millstein, Heather Mirletz, Heidi Hartmann, and James McCall, *Environmental and Circular Economy Implications of Solar Energy in a Decarbonized U.S. Grid*, 2022, National Renewable Energy Laboratory, NREL/TP-6A20-80818, https://www.nrel.gov/docs/fy22osti/80818.pdf.
[44] Renata Leonhardt, Bram Noble, Greg Poelzer, Patricia Fitzpatrick, Ken Belcher, Gwen Holdmann,

“Advancing local energy transitions: A global review of government instruments supporting community energy,” *Energy Research & Social Science*, Volume 83, 2022, 102350, ISSN 2214-6296, https://doi.org/10.1016/j.erss.2021.102350.

[45] Andrew D. Mills, Dev Millstein, Ryan Wiser, Joachim Seel, Juan Pablo Carvallo, Seongeun Jeong, and Will Gorman, "Impact of Wind, Solar, and Other Factors on Wholesale Power Prices: An Historical Analysis—2008 through 2017," Lawrence Berkeley National Laboratory, November 2019, https://eta-publications.lbl.gov/sites/default/files/lbnl_-_wind_and_solar_impacts_on_wholesale_prices_approved.pdf.

[46] "Solar Lease," Solar.com, accessed October 20, 2023, https://www.solar.com/learn/solar-lease/.

[47] Renewables to the Rescue: Stability for the Grid as It Loses Spin," National Renewable Energy Laboratory, last modified August 21, 2020, https://www.nrel.gov/news/features/2020/renewables-rescue-stability-as-the-grid-loses-spin.html.

[48] "Enabling Renewable Energy with Battery Energy Storage Systems," McKinsey & Company, accessed October 20, 2023, https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/enabling-renewable-energy-with-battery-energy-storage-systems.

[49] NARUC (National Association of Regulatory Utility Commissioners), "Staff 'Surge Call' – Monday, April 24th, 2023: DER Compensation in a Post-Net Metering World,” 2023, https://pubs.naruc.org/pub/48E8CDA7-D912-595F-766D-956DB7B1D339?mobileformat=false.

[50] Fitzgerald, Garrett, James Mandel, Jesse Morris, and Hervé Touati, "The Economics of Battery Energy Storage: How multi-use, customer-sited batteries deliver the most services and value to customers and the grid,” RMI, September 2015, http://www.rmi.org/electricity_battery_value.

[51] US Department of Energy Solar Energy Technologies Office (SETO) and National Renewable Energy Laboratory (NREL), "The Solar Futures Study,” September 2021, https://www.energy.gov/sites/default/files/2021-09/Solar%20Futures%20Study.pdf.

[52] Naïm R. Darghouth et al., "Demand charge savings from solar PV and energy storage," *Energy Policy* vol. 146 (2020): 111766, November 2020, https://doi.org/10.1016/j.enpol.2020.111766.

[53] Cross-Call, Dan, Rachel Gold, Leia Guccione, Mike Henchen, and Virginia Lacy, “Reimagining the Utility: Evolving the Functions and Business Model of Utilities to Achieve a Low-Carbon Grid,” RMI, January 2018, https://www.rmi.org/reimagining_the_utility.

[54] US Department of Energy Solar Energy Technologies Office, "Solar Integration: Solar Energy and Storage Basics,” National Renewable Energy Laboratory, accessed on September 27, 2023, https://www.energy.gov/eere/solar/solar-integration-solar-energy-and-storage-basics.

[55] SETO and NREL, "The Solar Futures Study,” September 2021, https://www.energy.gov/sites/default/files/2021-09/Solar%20Futures%20Study.pdf.

[56] Ciriaco, Thayanne and Wong, Stephen, "Review of resilience hubs and associated transportation needs," *Transportation Research Interdisciplinary Perspectives* vol. 16 (2022): 100697, December 2022, https://doi.org/10.1016/j.trip.2022.100697.

[57] Cook, Jeffrey J., Kaifeng Xu, Sushmita Jena, Minahil Sana Qasim, and Jenna Harmon, "Check the Storage Stack: Comparing Behind-the-Meter Energy Storage State Policy Stacks in the United States,” National Renewable Energy Laboratory, 2022, NREL/TP-6A20-83045, https://www.nrel.gov/docs/fy22osti/83045.pdf.

[58] Finnigan, Jennifer, and Ronda Strauch, "A Utility’s Clean Energy Equity Plan,” Seattle City Light, 2022 Summer Study on Energy Efficiency in Buildings, https://aceee2022.conferencespot.org/event-data/pdf/catalyst_activity_32481/catalyst_activity_paper_20220810190541724_536fe2fa_eed8_4355_b4a1_71bab1c72d27.

[59] Clean Energy States Alliance, "Directory of State Low- and Moderate-Income Clean Energy Programs," accessed October 31, 2023, https://www.cesa.org/resource-library/resource/directory-of-state-low-and-moderate-clean-energy-programs/.
[60] Lower Income Solar Energy Program (LISEP), NV Energy and the Nevada Governor's Office of Energy, accessed October 25, 2023, https://energy.nv.gov/Programs/Lower_Income_Solar_Energy_Program/
[61] "Bring Your Own Device," Green Mountain Power, accessed October 25, 2023, https://greenmountainpower.com/rebates-programs/home-energy-storage/bring-your-own-device/
[62] Environmental Protection Agency (EPA), "Renewable Energy Certificates (RECs)," accessed October 25, 2023, https://www.epa.gov/green-power-markets/renewable-energy-certificates-recs
[63] Federal Trade Commission (FTC), "16 CFR Part 260: Guides for the Use of Environmental Marketing Claims (Green Guides)," accessed October 25, 2023, https://www.ftc.gov/sites/default/files/attachments/press-releases/ftc-issues-revised-green-guides/greenguides.pdf
[64] Federal Trade Commission (FTC), "16 CFR Part 260: Guides for the Use of Environmental Marketing Claims (Green Guides)," accessed October 25, 2023, https://www.ftc.gov/sites/default/files/attachments/press-releases/ftc-issues-revised-green-guides/greenguides.pdf
[65] Lazar, J., Electricity Regulation in the US: A Guide. Second Edition. Montpelier, VT: The Regulatory Assistance Project, 2016, http://www.raponline.org/knowledge-center/electricityregulation-in-the-us-a-guide-2.
[66] Ramirez, Rachel, "Report: These rarely-used, dirty power plants could be cheaply replaced by batteries," Grist, June 11, 2020, https://grist.org/energy/report-these-rarely-used-dirty-power-plants-could-be-cheaply-replaced-by-batteries/.
[67] Fitzgerald, Garrett, James Mandel, Jesse Morris, and Hervé Touati, *The Economics of Battery Energy Storage: How multi-use, customer-sited batteries deliver the most services and value to customers and the grid*, RMI, September 2015, https://rmi.org/wp-content/uploads/2017/03/RMI-TheEconomicsOfBatteryEnergyStorage-FullReport-FINAL.pdf; and Hawaiian Electric, "Customer Incentive Programs," accessed October 31, 2023, https://www.hawaiianelectric.com/products-and-services/customer-incentive-programs/incentive-programs.
[68] Martin, Liza, and Kevin Brehm, "Clean Energy 101: Virtual Power Plants," RMI, January 10, 2023, https://rmi.org/clean-energy-101-virtual-power-plants/.
[69] Taylor, Mike, Joyce McLaren, Karlynn Cory, Ted Davidovich, John Sterling, and Miriam Makhyoun, "Value of Solar: Program Design and Implementation Considerations," Solar Electric Power Association and National Renewable Energy Laboratory, Technical Report NREL/TP-6A20-62361, March 2015, National Renewable Energy Laboratory, https://www.nrel.gov/docs/fy15osti/62361.pdf.
[70] Farrell, John, "Minnesota's Value of Solar: Can a Northern State's New Solar Policy Defuse Distributed Generation Battles?" Institute for Local Self-Reliance, April 2014, https://ilsr.org/wp-content/uploads/2014/04/MN-Value-of-Solar-from-ILSR.pdf.
[71] Sherwood, James et al., "A Review of Alternative Rate Designs: Industry experience with time-based and demand charge rates for mass-market customers," RMI, May 2016, http://www.rmi.org/alternative_rate_designs.
[72] Dan Cross-Call and James Sherwood, "Moving to Better Rate Design," RMI, May 17, 2016, https://rmi.org/blog_2016_05_17_moving_to_better_rate_design.
[73] Fields, Spencer, "Critical Peak Pricing: What You Need to Know," EnergySage, October 17, 2023, https://www.energysage.com/electricity/critical-peak-pricing-overview/.

[74] Dan Cross-Call and James Sherwood, "Moving to Better Rate Design," RMI, May 17, 2016, https://rmi.org/blog_2016_05_17_moving_to_better_rate_design.

[75] US Environmental Protection Agency, Office of Atmospheric Programs, Climate Protection Partnerships Division, "Standby Rates for Customer-Sited Resources: Issues, Considerations, and The Elements Of Model Tariffs," December 2009, https://www.raponline.org/wp-content/uploads/2016/05/rap-weston-standbyratesforcustomersitedresources-2009-dec.pdf.

[76] US Department of Energy, Office of State and Community Energy Programs, "On-Bill Financing and Repayment Programs," State and Local Solution Center, accessed November 1, 2023, https://www.energy.gov/scep/slsc/bill-financing-and-repayment-programs.

[77] Yañez-Barnuevo, Miguel, "Colorado Utility Launches Innovative Financing Tool for Battery Storage," Environmental and Energy Study Institute (EESI), December 10, 2020, https://www.eesi.org/articles/view/colorado-utility-launches-innovative-financing-tool-for-battery-storage.

[78] "Utility-Owned Rooftop Solar," Western Energy Institute, December 3, 2015, https://www.westernenergy.org/news-resources/utility-owned-rooftop-solar/; "Duke Energy: Land Sales and Leasing," Duke Energy, accessed November 1, 2023, https://www.duke-energy.com/Our-Company/About-Us/New-Generation/Sell-or-Lease-Land-for-Solar-Energy.

[79] "Utility-Owned Rooftop Solar," Western Energy Institute, December 3, 2015, https://www.westernenergy.org/news-resources/utility-owned-rooftop-solar/.

[80] Catherine Lane, "Green Mountain Power's new energy storage lease explained," *SolarReviews,* updated September 12, 2022, https://www.solarreviews.com/blog/green-mountain-power-energy-storage-lease-program.

[81] United States Environmental Protection Agency, "Overview of EPA's Brownfields Program," Overviews and Factsheets, January 8, 2014, https://www.epa.gov/brownfields/overview-epas-brownfields-program.

[82] Wall, Malkie, David Madland, and Karla Walter, "Prevailing Wages: Frequently Asked Questions," *Center for American Progress*, December 22, 2020, https://www.americanprogress.org/article/prevailing-wages-frequently-asked-questions/.

[83] Schurle, Adam, David Weisblat, and Tori Roessler, "Prevailing Wage and Apprenticeship Guidance for ITC and PTC | Foley & Lardner LLP," accessed August 2, 2023, https://www.foley.com/en/insights/publications/2022/11/prevailing-wage-apprenticeship-guidance-itc-ptc.