

RESILIENTPOWER

A project of **CleanEnergy**Group



Tools for Building More Resilient Communities with Solar+Storage

Housekeeping



← All participants are in “Listen-Only” mode. Select “Use Mic & Speakers” to avoid toll charges and use your computer’s VOIP capabilities. Or select “Use Telephone” and enter your PIN onto your phone key pad.

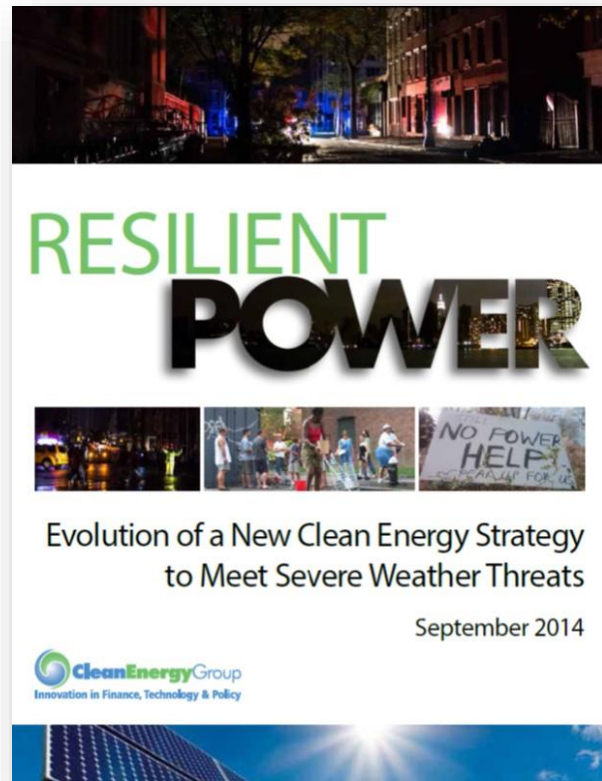
← Submit your questions at any time by typing in the Question Box and hitting Send.

This webinar is being recorded.

You will find a recording of this webinar, as well as previous Resilient Power Project webinars, online at:

www.resilient-power.org

Who We Are



www.cleanegroup.org

www.resilient-power.org



SURDNA FOUNDATION

Fostering sustainable communities in the United States

Today's Speakers

- **Seth Mullendore**, Project Director, Clean Energy Group
- **Rob Sanders**, Senior Finance Director, Clean Energy Group



What is Resilient Power?

Resilient power is the ability not only to provide critical power to essential facilities and services during a power outage, but also to provide economic benefits throughout the year.



Why the Resilient Power Project?



Extended power outages disproportionately harm low-income, elderly, disabled and otherwise disadvantaged communities

Hurricane Sandy:

110 US fatalities and \$42+ billion in property damage - costliest U.S. hurricane.

In Red Hook, New York (Brooklyn), the borough's largest housing project, 4,000 of the 6,000 residents had no heat or water for over a week after the storm.

Resilient Power Equity Divide



High-End Markets

- Thousands of projects built
- Mainly to reduce electric bills
- Will grow exponentially like solar
- New financing options emerging
- Will become status quo offering

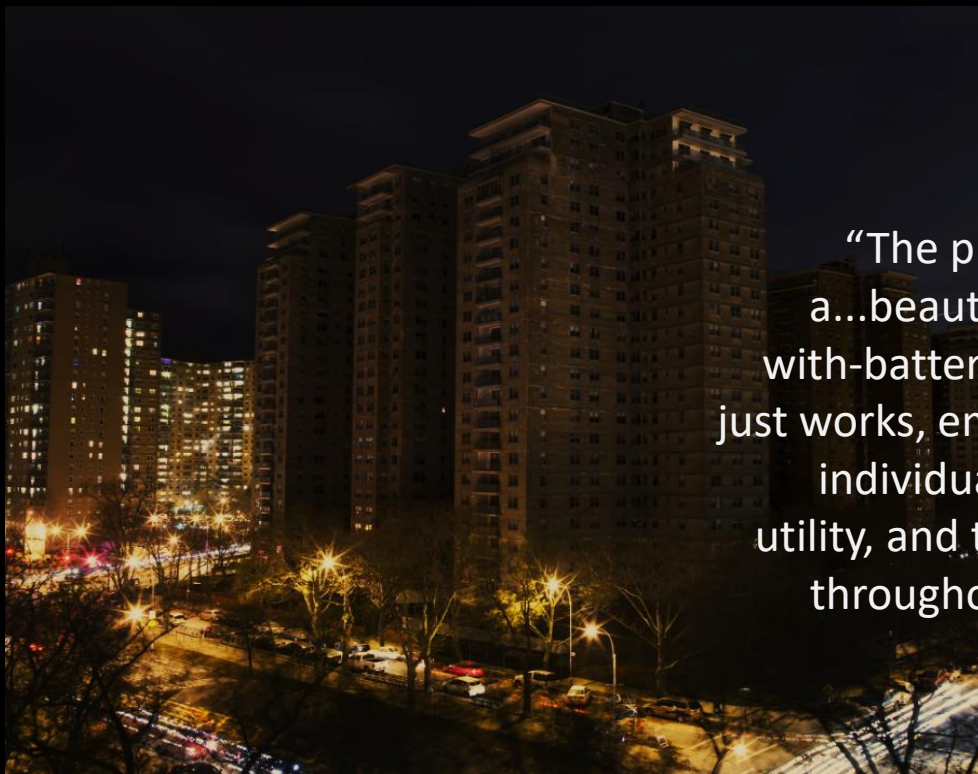


LMI Markets

- Few projects built
- Greater need for technology
- Unequal incentives distribution
- Difficult to finance under traditional models
- Few targeted LMI strategies

Bridging the Resilient Power Divide

“Electricity was not fully restored...until three weeks after Sandy landed.” -Urban Health



“The plan is to create a...beautiful solar-roof-with-battery product that just works, empowering the individual as their own utility, and then scale that throughout the world.”
-Elon Musk



Affordable Housing and Critical Facilities



Resilient Power Toolkits

You are here: [Home](#) / [Projects](#) / [Resilient Power Project](#) / [Resilient Power Toolkits](#)

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Resilient Power Toolkits

Resilient power, supplied by clean, renewable technologies, can help strengthen communities by delivering resiliency, economic, and health benefits. The [community services](#) and [affordable housing](#) toolkits listed below are designed to provide the tools and background information to gain a better understanding of resilient power systems and how to approach the planning and development of a resilient power installation. Resources include descriptions and links to key reports, guides, and webinars produced by Clean Energy Group and other organizations.

Community Services

Resources for developing resilient power projects in shelters, first response, and other critical community facilities.

Affordable Housing

Resources for developing resilient power projects in single family and multifamily affordable housing developments.



Resilient Power Toolkits

[Return to Toolkits Main Page](#)

Community Services Toolkit

Are there critical facilities (emergency shelters, first response, healthcare centers) in your community that could benefit from clean, reliable power? The information and resources listed below will help you explore how the social and economic benefits of resilient power can help strengthen your community. Resources include descriptions and links to key reports, guides, and webinars produced by the Resilient Power Project and other organizations.

If you have any questions or would like to learn more about resilient power for community services, please contact us at resilient-power@cleangroup.org.

Information specific to resilient power for affordable housing is available [here](#).



Read more about these resilient community projects on the [Featured Installations page](#).

Background on Resilient Power Technologies

Resilient power is the ability to provide a facility with continuous, reliable power even when the electric grid goes down. Truly resilient power should be clean, renewable, and have the ability to provide benefits throughout the year, not just during natural disasters and other power emergencies. The resources listed below provide a more in-depth look at the components of a resilient solar+storage system, including an introduction for those new to solar+storage technologies ([Solar+Storage 101](#)) and considerations for projects interested in adding storage to an existing solar system ([Resilient PV Retrofit and Storage Ready Guidelines](#)).

[+ View All Resources](#)

Resilient Power Toolkits

Six Toolkit Focus Areas:

- 1) Background on Resilient Power Technologies
- 2) Resilient Power Economics
- 3) Financing Resilient Power Projects
- 4) Developing a Resilient Power Project
- 5) Resilient Power Policies
- 6) Additional Resources

Resilient Power Technologies

Background on Resilient Power Technologies

Resilient power is the ability to provide a facility with continuous, reliable power even when the electric grid goes down. Truly resilient power should be clean, renewable, and have the ability to provide benefits throughout the year, not just during natural disasters and other power emergencies. The resources listed below provide a more in-depth look at the components of a resilient solar+storage system, including an introduction for those new to solar+storage technologies ([Solar+Storage 101](#)) and considerations for projects interested in adding storage to an existing solar system ([Resilient PV Retrofit and Storage Ready Guidelines](#)).

 View All Resources

Solar+Storage 101: An Introductory Guide to Resilient Solar Power Systems (Clean Energy Group, 2015)

This guide provides a basic technical background and overview of solar+storage systems. It is meant as a starting point for project developers, building owners, facility managers, and state and municipal planners to become familiar with solar+storage technologies, how they work, and what's involved in getting a new project off the ground.

Resilient Power Project Frequently Asked Questions (Clean Energy Group)

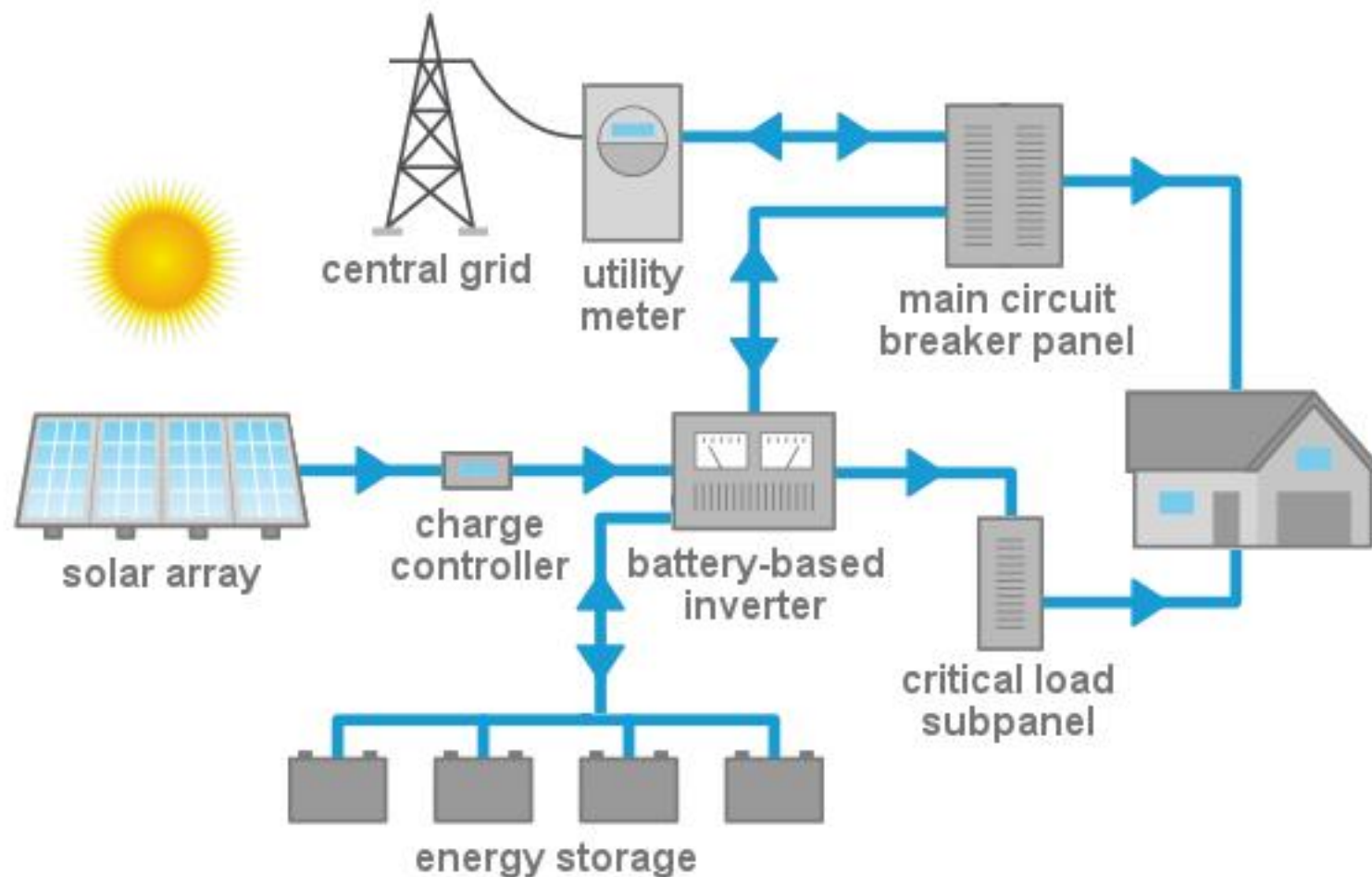
Answers to frequently asked questions about Clean Energy Group's Resilient Power Project, such as "What is resilient power?" and "How can the Resilient Power Project help me develop a project?"

Resilient PV Retrofit and Storage Ready Guidelines (City University of New York, National Renewable Energy Lab, Meister Consultants Group, 2016)

This fact sheet provides information to installers, utilities, policy makers, and consumers on how to add an energy storage system to existing solar PV systems to create resilient PV or make new PV systems "storage ready".

- Webinar – **Resilient Solar Retrofits: Adding Storage to Existing PV and Making New Installations Storage Ready** (Clean Energy Group, City University of New York, National Renewable Energy Laboratory, 2016)

Solar+Storage 101



Resilient PV Retrofit Guide

Equipment needed to add an ESS to a residential or small scale commercial solar PV system:

- Batteries
- Dual function inverter
- Critical Load Panel
- Isolating Switches
- Controls
- Metering
- Balance of System Items (racking, wire, etc.)
- Transfer Switch (automatic or manual)

*In order to implement a **DC coupled** system:*

- Remove the existing grid tied inverter
- Add a dual function inverter
- Add a transfer switch (if not included in the inverter)
- Add a charge controller
- Add a battery bank
- Add a DC disconnect
- Configure controls hardware/software
- Isolate critical loads
- Add surge protectors (optional)

*In order to implement an **AC coupled** system:*

- Add a dual function inverter to the system
- Add a transfer switch (if not included in the inverter)
- Connect the existing grid tied inverter to the dual function inverter
- Add a battery bank
- Add a DC disconnect
- Configure controls hardware/software
- Isolate critical loads
- Add surge protectors (optional)

Resilient Power Economics

Resilient Power Economics

Resilient power systems can boost economic resiliency by reducing or stabilizing utility bills. In some cases, these systems can also generate revenue by providing valuable grid services. The resources listed below includes analyses of the economic case for resilient power systems ([The Economics of Battery Storage](#)) as well as tools to determine whether or not solar+storage makes economic sense for specific buildings ([Project Qualification Score Card](#)).

 [View All Resources](#)

The Economics of Battery Energy Storage (Rocky Mountain Institute, 2015)

This report explores four key questions: 1) What services can batteries provide to the electricity grid? 2) Where on the grid can batteries deliver each service? 3) How much value can batteries generate when they are highly utilized and multiple services are stacked? 4) What barriers currently prevent energy storage systems from providing multiple, stacked services to the electricity grid?

Energy Storage and Electricity Markets: The value of storage to the power system and the importance of electricity markets in energy storage economics (Clean Energy Group, 2015)

This report introduces electricity markets where storage has begun to play a significant role. The report examines how emerging energy storage markets have developed and the potential for realizing additional value streams through new market mechanisms.

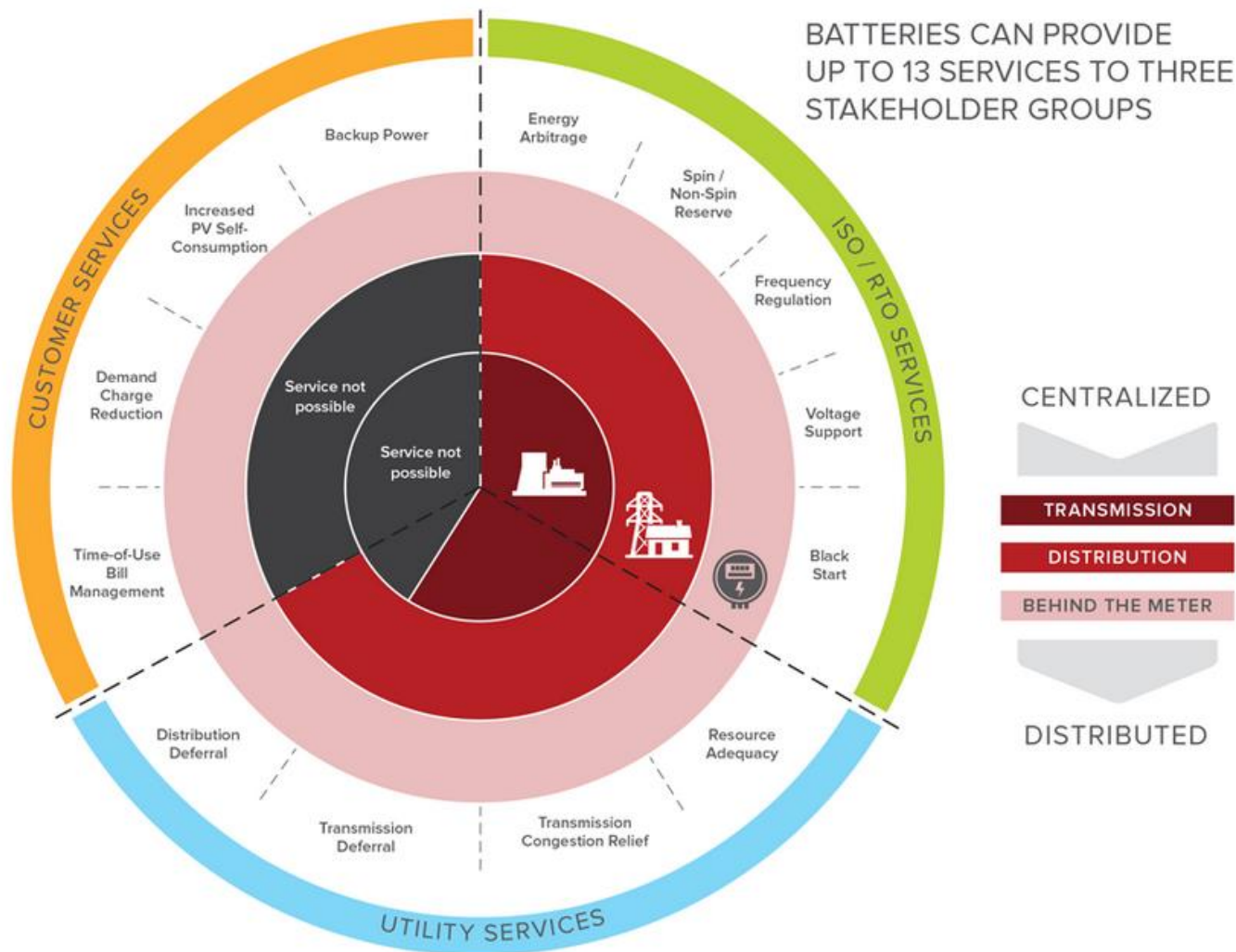
- Webinar – **Electricity Markets and the Economics of Energy Storage** (Clean Energy Group, Intelligent Generation, 2015)

Project Qualification Score Card (Geli, 2016)

Simple scorecard to help developers determine which projects may have the greatest potential economic outcome for solar+storage development.

Levelized Cost of Storage Analysis 2.0 (Lazard, 2016)

The Economics of Battery Storage



Energy Storage and Electricity Markets

Utility Demand Management

Demand response	Discharging stored energy to supply on-site electricity demand in response to utility signals for demand response, which occur at times when power system demand is approaching available supply.
Peak capacity	Generation capacity deployed when electricity demand is higher than available supply of normal capacity resources, often provided by natural gas-fired combined cycle power plants.

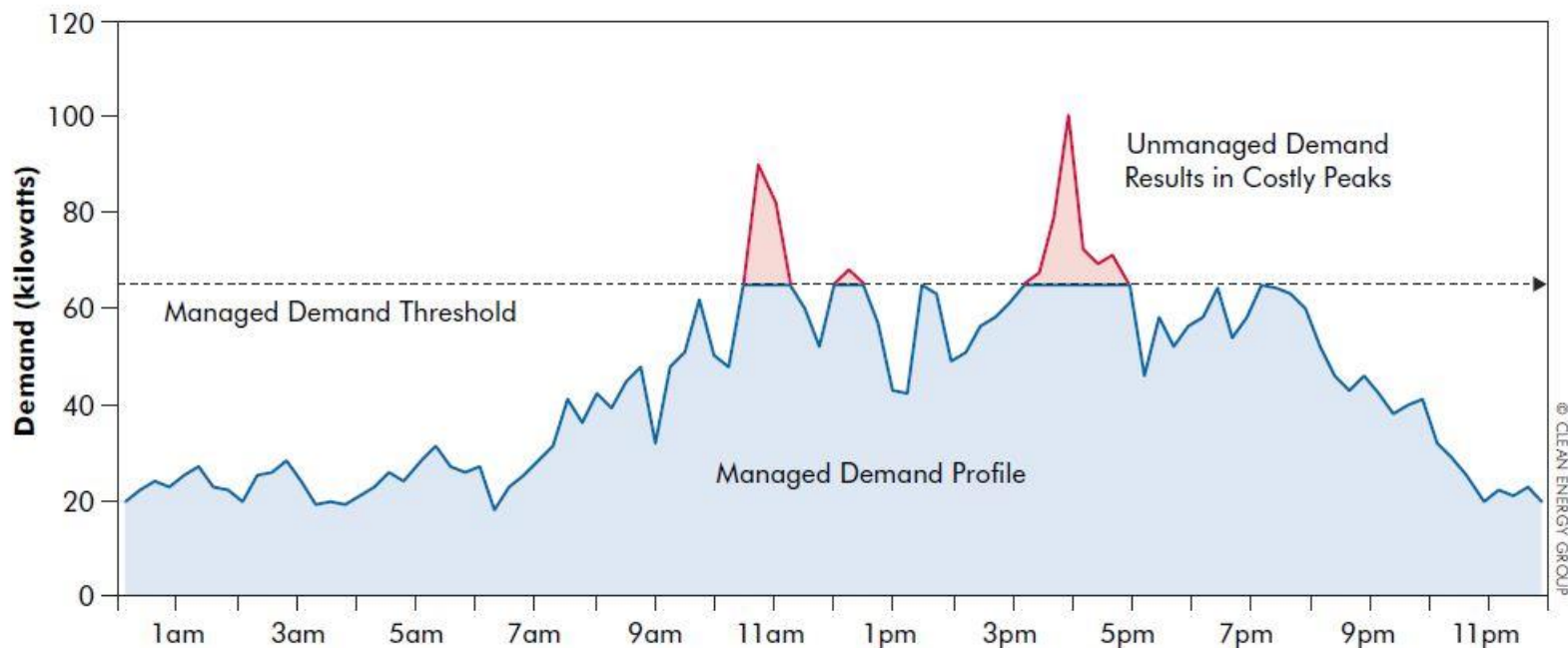
Grid Balancing

Ancillary services	Ensuring the quality and reliability of electricity production, transmission, and distribution. See Table 1 (p. 6) for a detailed description of the most common ancillary services.
Power quality	Energy storage can insulate downstream loads from power quality disruptions, such as voltage spikes or dips, frequency imbalances, or a low power factor.
Ramping	Charging or discharging energy over a sustained period in response to rapid increases or decreases in supply and demand. This function is particularly beneficial in areas of high solar penetration when solar production ramps up in the morning and down in the evening.

Energy Transmission & Distribution

Transmission system support	Improving the performance of transmission and delivery systems by correcting for voltage and resonance issues.
Transmission system congestion relief	Discharging energy downstream of points of high demand during peak periods when transmission systems can become overloaded and congested or charging to relieve periods of excess supply.
Transmission & distribution upgrade deferral	Similar to congestion relief, by deploying energy storage downstream from regions of congested transmission, the need for more costly transmission and distribution system upgrades can be delayed or entirely eliminated.
Utility substation power	Providing power to substation control equipment, switching components, and communications systems when grid power is unavailable.

Energy Storage and Electricity Markets



Peak reduced from 100 kW to 65kW = 35 kW reduction

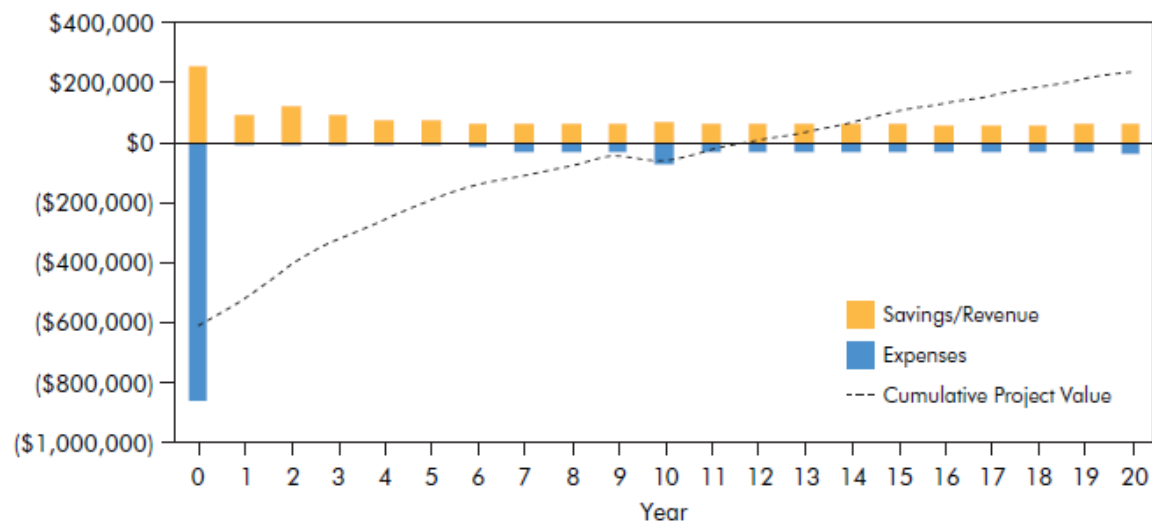
@ \$10/kW = \$4,200 annual savings

@ \$20/kW = \$8,400 annual savings

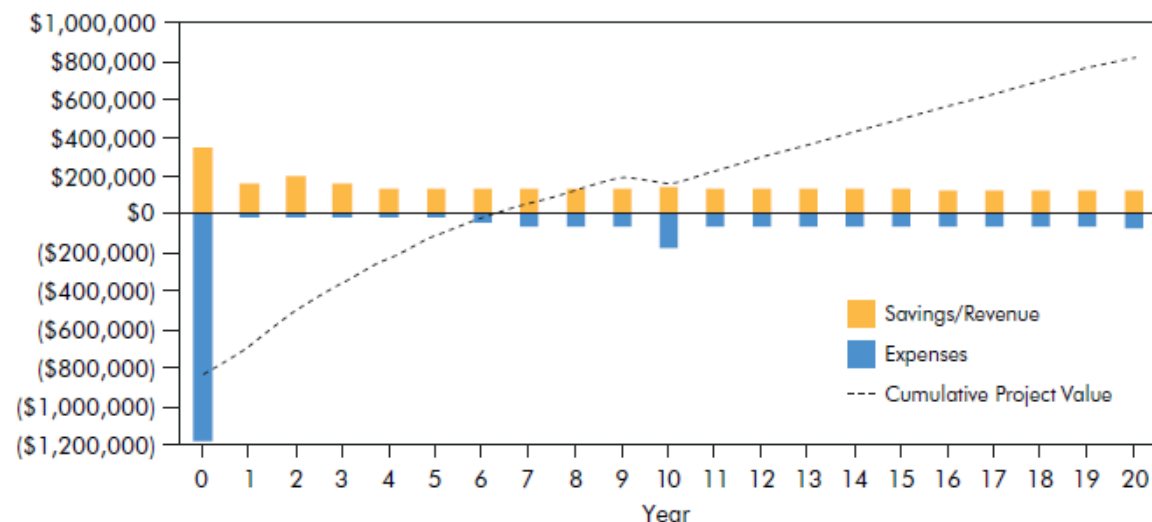
Resilience for Free

Affordable Housing: Chicago, DC, NYC

Solar-only
11.8 year payback



Solar+Storage
6.2 year payback

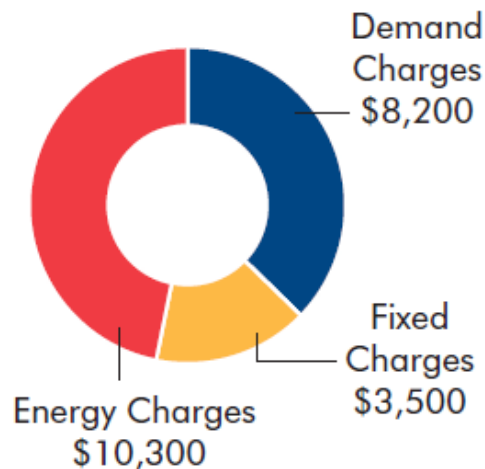


Closing the CA Clean Energy Divide

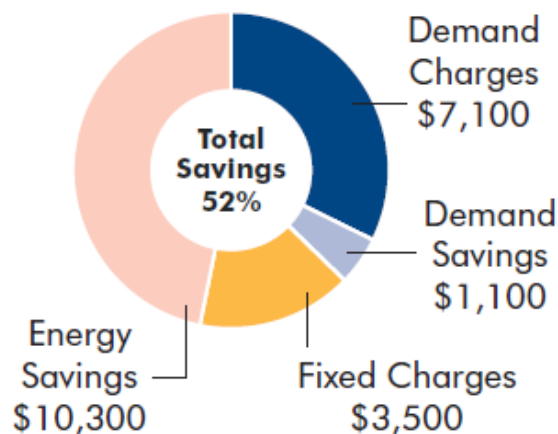
Affordable Housing in California:

Example of Impacts from the Addition of Solar and Solar+Storage on Electricity Bills

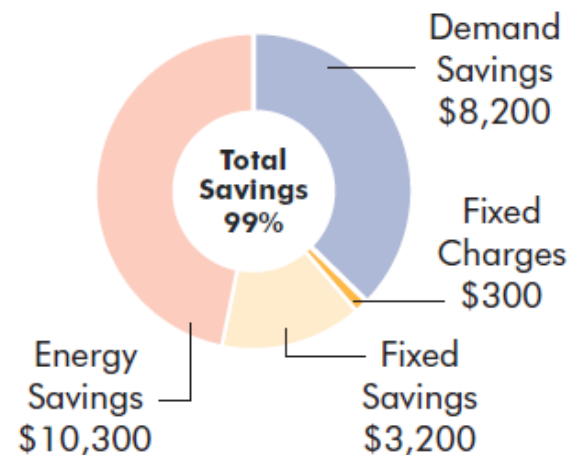
Original Electric Bill
\$22,000








Bill with Solar
\$10,700



Bill with Solar+Storage
\$300



Project Qualification Scorecard

Type	Category	Description	Scoring Rubric	Score
	High energy charges	The greater the retail energy rate (\$/kWh), the more valuable the solar PV generation	0 < \$0.10/kWh 1 ≥ \$0.10/kWh	
	Net metering	The ability to receive credit from the utility for solar over-generation at, or close to, the full retail energy rate	0 Over-generation credited at 0-85% of the full retail rate 1 Over-generation credited at 85-100% of the full retail rate	
	State/local incentives	State and local solar incentives (renewable energy credits, rebates, and tax credits)	0 No incentives 1 Incentives	
	High demand charges	The more expensive the demand charge, the greater the arbitrage opportunity	0 < \$13/kW 1 ≥ \$13/kW	
	Peak loads*	Peak shaving is most effective for peak events that last fewer than 30-90 minutes. Adding solar PV to a building can make its load profile more attractive for demand charge management.	0 Flat loads or long duration peaks (> 90 mins) 1 Short durations peaks (30-60 mins)	

Resilient Power Policies

Resilient Power Policies

Many states and communities are beginning to lead the way in supporting resilient power technologies through supportive policies and market mechanisms. The following resources are intended to give policymakers and advocates an overview of existing policies and programs ([Solar+Storage for Low- and Moderate-Income Communities](#)), along with guidance to inform the design of new resilient power initiatives ([Does Energy Storage Fit in an RPS?](#)).

 View All Resources

Solar+Storage for Low- and Moderate-Income Communities: A Guide for States and Municipalities (Clean Energy States Alliance, 2017)

This guide seeks to provide state and municipal officials with information to develop effective solar+storage policies and programs that benefit low- and moderate-income (LMI) communities. It explores a range of policy approaches that have been successfully employed and provides program examples from states that have made LMI access to these technologies a priority.

- Webinar: **Solar+Storage for Low- and Moderate-Income Communities** (Clean Energy States Alliance, 2017)

What States Should Do: A Guide to Resilient Power Programs and Policy (Clean Energy Group, 2015)

This guidebook is intended to help states establish new policies and support new markets to advance clean resilient power nationwide. It profiles leading state programs and makes recommendations for what other states can do to support the deployment of resilient power systems.

- Webinar – **What States Should Do: A Guide to Resilient Power Programs and Policy** (Clean Energy Group, Massachusetts Department of Energy Resources, Oregon Department of Energy, New Jersey Energy Resilience Bank, 2015)

What Cities Should Do: A Guide to Resilient Power Planning (Clean Energy Group, 2015)

This paper calls for a systematic approach to protecting critical facilities with smarter resilient power solutions. It presents series of guidelines and best practices for cities and towns preparing to deal with the impacts of severe weather events.

Solar+Storage for LMI Communities

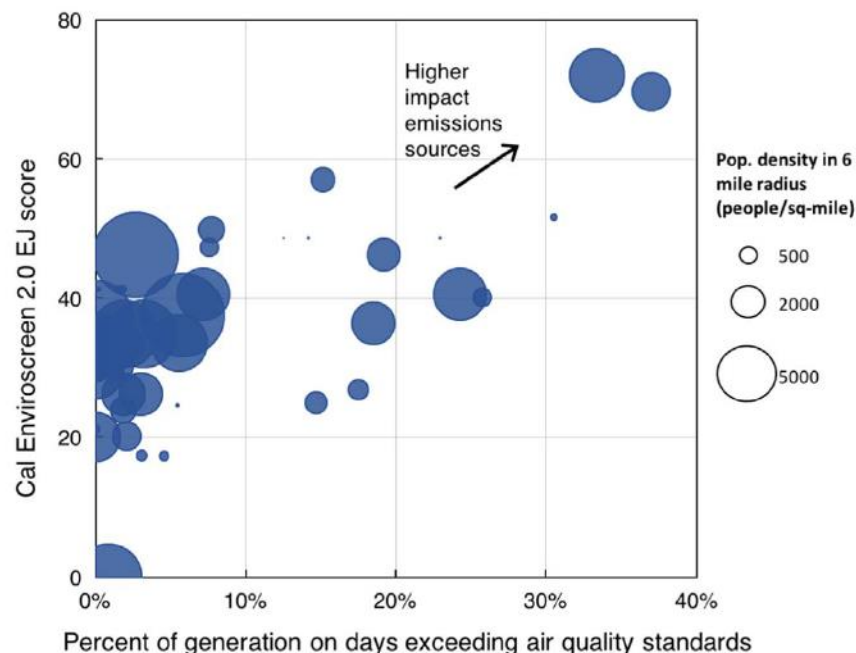
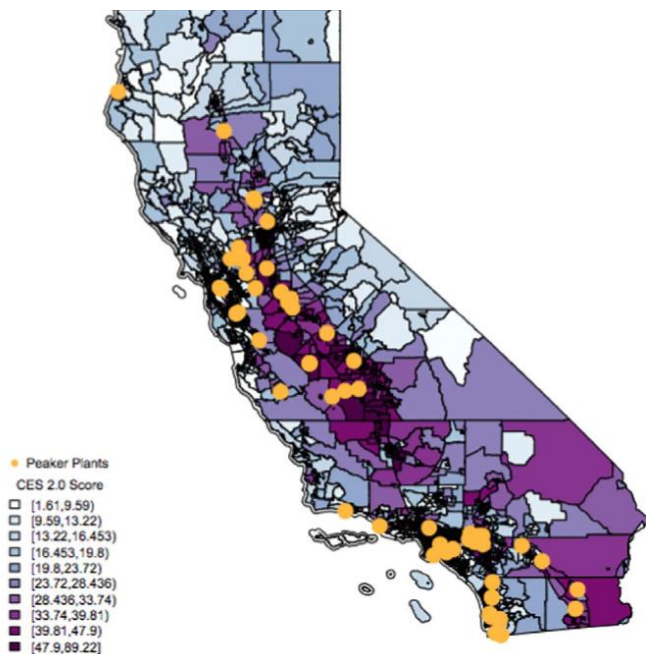
This section reviews the various types of supports that states and municipalities can use to promote solar+storage benefiting LMI communities:

- Grants
- Rebates
- Incorporating Solar+Storage into Existing Programs
- Utility Mandates/Procurement
- Portfolio Standards
- Tax Incentives
- Alternative Ownership Structures
- Financing
- Clean Energy Financial Institutions
- Market-Based Tools and Regulatory Reform
- Technical Assistance, Tools, and Resources

The compensation mechanisms available to energy storage providers are inadequate. Consequently, many benefits of energy storage are not fully realized or are not considered cost effective.

Solar+Storage for Public Health

“[This new siting strategy] can be used to identify regions where integrating clean technologies will help realize greater human health and EJ co-benefits... Meeting peak demand, and therefore reducing peaker plant demand, is one of the primary use cases for energy storage and demand response.”



Krieger E, Casey J, Shonkoff SBC. *A framework for siting and dispatch of emerging energy resources to realize environmental and health benefits: Case study on peaker power plant displacement.* <http://www.sciencedirect.com/science/article/pii/S0301421516302798>

Developing a Resilient Power Project

Developing a Resilient Power Project

There are a number of questions and considerations that should be explored when beginning to develop a new resilient power project. The resources below can help guide you through the process of planning a resilient power installation, including basic step-by-step guidance for approaching a new project ([Solar+Storage Project Checklist](#)) and sample Request for Proposal (RFP) templates for both large-scale and behind-the-meter resilient power installations ([Energy Storage Procurement Guidance Documents for Municipalities](#)).

 View All Resources

Solar+Storage Project Checklist (Clean Energy Group, 2016)

This checklist is intended to serve as a starting point for developers and planners who are considering implementing a solar+storage project. It focuses on basic questions and considerations that should be explored throughout the decision-making process and suggests some initial steps to consider when beginning a new project.

Energy Storage Procurement Guidance Documents for Municipalities (Sandia National Laboratories, Clean Energy States Alliance, Clean Energy Group, 2016)

This guide offers useful information for municipalities to consider as they develop solicitations for resilient energy storage projects. The materials are designed to give specific examples of the elements that should be included in a solicitation for the procurement and installation of a battery storage project that is designed to provide backup power during outages, including a matrix of elements to include in a Request for Proposals (RFP) and sample RFP templates for utility-scale and behind-the-meter storage projects.

- Webinar – **Procurement Guidance for Energy Storage Projects: Help with RFIs, RFQs and RFPs** (Sandia National Laboratories, Bright Power, Clean Energy States Alliance, Clean Energy Group, 2016)

Assessing Critical Loads in Community Facilities (Arup, 2015)

This report evaluates emergency load profiles by identifying critical loads and backup power needs for five building types: Department Operating Center, Recreational Center, Police Station, Fire Station, and Cooking Facility. These critical load profiles were developed specifically for San Francisco, California, but the methodologies used and basic findings are broadly applicable to other locations.

Solar+Storage Project Checklist



Get to know your utility bill

Becoming more familiar with your building's energy needs and utility rate structure is a good first step in thinking about a solar+storage system. Your electric utility may be able to assist you in answering the following questions.

QUESTIONS TO CONSIDER

- ☐ What is your monthly/annual energy use (kWh)?
- ☐ Are you subject to demand charges? If so, how much are they (\$/kW)?
- ☐ Are you on a time-of-use rate structure that may reward you for shifting loads to off-peak periods? If not, does your utility offer a time-of-use rate option?



Seek out expert advice

There are a lot of steps involved and things to consider when planning a solar+storage system. Connect with professionals who have experience and technical expertise in solar+storage to help you evaluate your options and examine potential solutions. A bit of guidance can help your project move forward and ensure you'll benefit from the experience of others.

Clean Energy Group may be able help get you on the right track. Contact resilient-power@cleanegroup.org if you are working on an affordable housing or community-based solar+storage project and could use some assistance.

QUESTIONS TO CONSIDER

- ☐ Does your organization have internal energy analysis and technical planning expertise?
- ☐ Do you have a strong understanding of the economics of solar+storage systems?

Energy Storage Procurement

SANDIA REPORT

SAND2016-8544 0 Unlimited Release
Printed September, 2016

Energy Storage Procurement Guidance Documents for Municipalities

Daniel Borneo (SNL)

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Sandia National Laboratories

(ORGANIZATION) FOR THE (MUNICIPALITY)
REQUEST FOR PROPOSALS – ENERGY STORAGE SYSTEM
FOR THE COMMUNITY CLEAN ENERGY RESILIENCY INITIATIVE

[Title and Solicitation Number]

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Sec-B-2

Featured Installations

Affordable Housing:

- McKnight Lane Redevelopment Project, VT (Rural modular housing)
- Marcus Garvey Apartments, NY (Urban apartment building)
- 2500 R Street Community Development, CA (Single family housing)

Emergency Shelter:

- Hartley Nature Center, MN (Community center)
- Stafford Hill Solar Farm and Microgrid, VT (School)
- North Putnam Schools, IN (School)
- Scripps Ranch Microgrid, CA (Community center)
- Gardner Community Center, CA (Community center)
- SunSmart Emergency Shelters Program, FL (School)

Critical Services:

- Sterling Municipal Substation, MA (Police station, Communications)
- McAlpine Creek Demonstration Project, NC (Fire station)

Community Microgrid

- American Samoa Island Community Microgrid (Island community)



Technical Assistance Fund

- An essential market development tool - funded by foundations
- Grants pay for technical services to determine project feasibility
 - To date: A dozen elderly, family & supportive affordable housing projects in NYC, Chicago, DC and Newark NJ
- Require sharing of deal & financing docs, reporting of project performance for 2 years



TAF Guidelines

- *Geographic focus* - Located in low-income communities, also to provide critical services to LMI / other vulnerable populations
- *Project focus* - Distributed clean generation to support critical building loads independent of grid during power outage
- *Types of support* - 3rd-party technical services, predevelopment costs, program / project assistance to municipal officials
- *Grant amount* - Typical grant: \$5,000 to \$7,500, larger grants under special circumstances

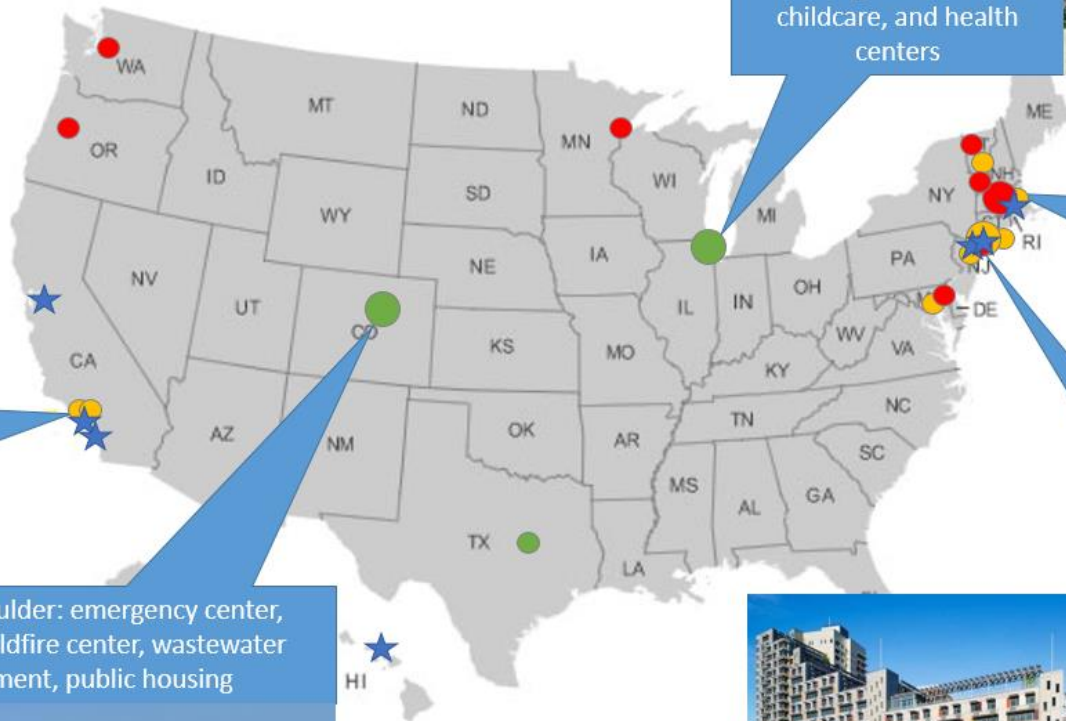


Supporting 50+ Projects Across U.S.

- ★ Leadership Awardee
- Affordable Housing
- Critical Facilities
- Both



California Multifamily Affordable Housing: AB 693 150,000 units



City of Boulder: emergency center, shelter, wildfire center, wastewater treatment, public housing



Chicago Housing Authority: 1,900 public housing units; senior, childcare, and health centers



Massachusetts Community Clean Energy Resiliency Initiative: 11 communities, 28 projects



New York/New Jersey: 9 multifamily affordable housing projects, community shelter



Outreach to Community Advocates



- Have reached 10,000 stakeholders this past year through webinars, presentations, reports, newsletters, articles.
- Need to do more to engage community advocates
- Connect energy resilience with environmental justice, health & economic equity work through leadership grants
- Have identified more than 70 community advocate networks already thinking about this who we would like to engage in community energy resilience

Resilient Power Community Leadership Grants



- Community-led programs that further advance energy equity & environmental justice
- To develop resilient power awareness & implementation strategies in low-income communities
 - CA Environmental Justice Alliance (**CEJA**) (Oakland & Huntington Park, CA)
 - The **Greenlining Institute** (Oakland, CA)
 - **LINC Housing** Corporation (Long Beach, CA)
 - Preservation of Affordable Housing (**POAH**) (Boston, MA)
 - **Sustainable Molokai** (Kaunakakai, HI)
 - **THE POINT** Community Development Corp (Bronx, NY)
 - **WE ACT** for Environmental Justice (NYC)

Financing Resilient Power Projects

Financing Resilient Power Projects

Community resilient power projects can be financed through a variety of mechanisms, including third-party power purchase agreements and leases, development loans, tax-exempt and taxable bonds, and commercial PACE financing. The resources below discuss consideration and strategies for financing a resilient power projects ([Financing for Clean, Resilient Power Solutions](#)).

 [View All Resources](#)

Financing for Clean, Resilient Power Solutions (Clean Energy Group, 2014)

This paper describes a broad range of financing mechanisms that are either just beginning to be used or that have a strong potential for providing low-cost, long-term financing for solar+storage projects. The goal is to identify financing tools that can be used to implement projects and that will attract private capital on highly favorable terms, thereby reducing the overall project cost.

Webinar – Financing Solar+Storage with Federal Tax Credits (Clean Energy Group, Deloitte Tax, 2016)

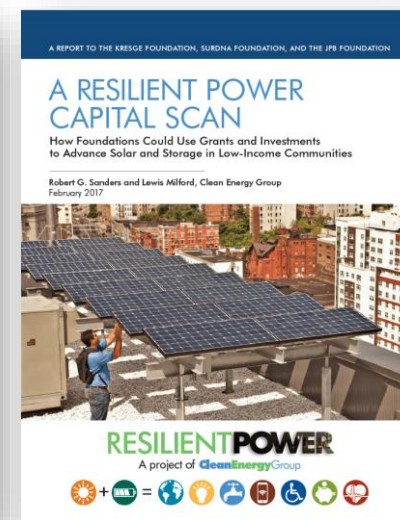
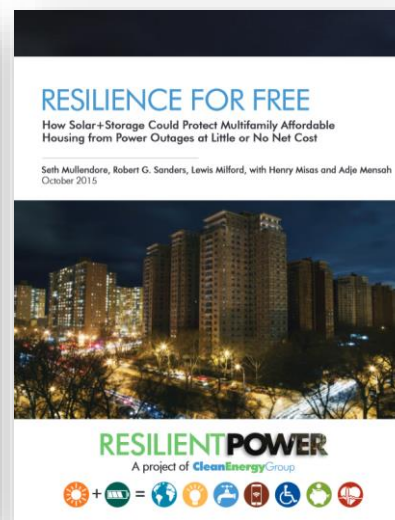
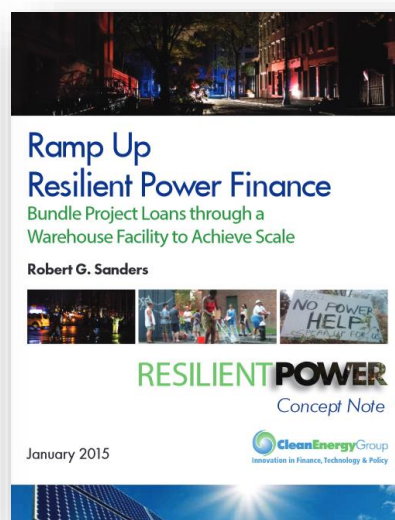
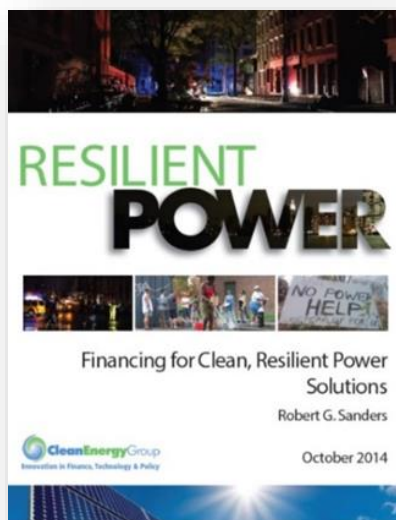
This webinar covers the historical treatment of energy storage combined with renewables under the U.S. Tax Code, as well as recent tax developments and a look at the future of solar+storage tax treatment under various use cases and new regulations.

A Resilient Power Capital Scan: How Foundations Could Use Grants and Investments to Advance Solar and Storage in Low-Income Communities (Clean Energy Group, 2017)

This report identifies market barriers to deploying solar+storage technologies in low-income markets, and proposes more than 50 grant and investment opportunities that socially minded investors can use to target those barriers.

Ramp Up Resilient Power Finance: Bundle Project Loans Through a Warehouse Facility to Achieve Scale (Clean Energy Group, 2015)

This report outlines a new clean energy finance model for many resilient power systems to protect vulnerable communities and critical infrastructure from severe weather events.



RESILIENT POWER

A Project of Clean Energy Group and Meridian Institute



RESILIENT POWER

PROTECTING COMMUNITIES IN NEED

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How Solar+Storage Projects are Financed Today

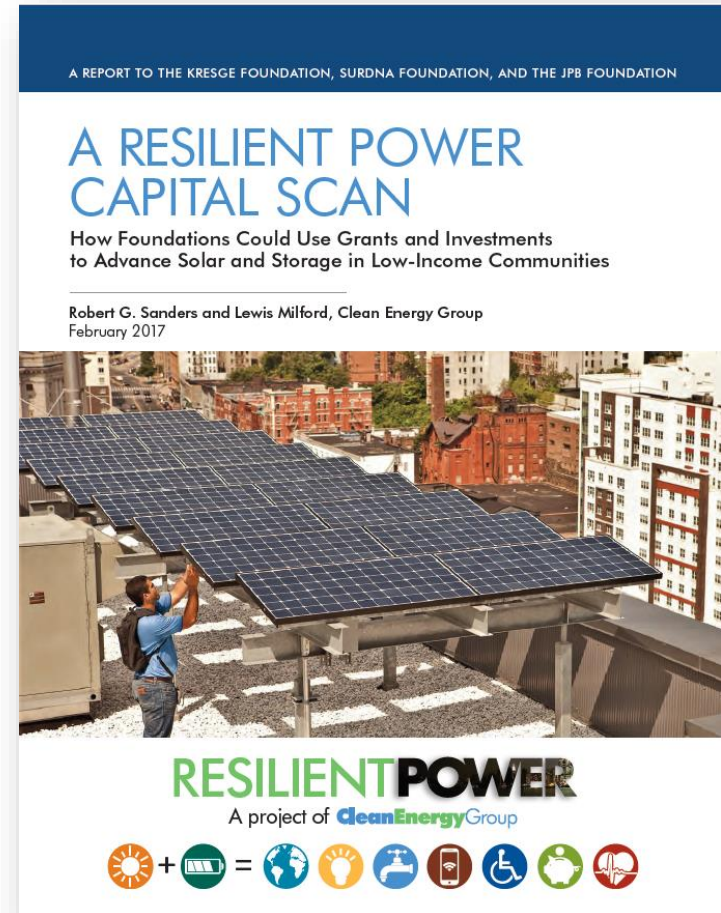
- *Utilities* - direct ownership or third-party ownership under long term contract for services (rate based)
 - Green Mountain Power - 4 MW of battery storage, 2.5 MW of solar PV, provides resilient power to a school community emergency shelter
 - PSE&G – Hopewell Valley High School (community emergency shelter)
- *Large energy services companies* - access to capital markets targeting specific sectors
 - (Schneider Electric, municipal water/sewer treatment facilities, MUSH)
- *New solar+storage companies* - using project finance funds, venture capital & private equity
Green Charge Networks, Stem, AF Mensah

How Solar+Storage Projects are Financed Today

- *Non-recourse project finance*
 - Macquarie/CIT finance facility for 50MW of CA behind-the-meter projects
- *State incentives* for demonstration projects
 - MA DOER
 - MD Energy Administration
- *Federal tax credits*
 - ITCs
 - For affordable housing, can be combined with LIHTCs to fully fund projects
- *Bond financing* for municipal projects, schools, large nonprofit institutions

A Resilient Power Capital Scan

In May 2016, The Kresge Foundation and Surdna Foundation and The JPB Foundation commissioned Clean Energy Group to conduct a “capital scan” of grant, PRI, and MRI investment opportunities in the resilient power solar and storage space.



Market Interviews and Recommendations

- Over 30 interviews with market players
- Identified barriers and interventions
- Examples of Investment Vehicles
- Still open to comment and reaction

“Affordable housing portfolio owners do not have sufficient usage data to make good judgments on new technology like solar and storage. Even in markets like California, it can be costly and difficult to obtain tenant interval data to fully assess the economic benefits of these new systems.”

“The irony is that the capital is out there, but the market conditions need to develop for LMI communities to access it – and it will not happen on its own.”

“PRIs must be as flexible as possible to be useful. Foundations should be willing to take some losses.”

Owning the Benefits of Solar+Storage

- *“Owning the Benefits of Solar+Storage: New Ownership and Investment Models for Affordable Housing”*
 - Immediate direct ownership
 - Third-party ownership flips
 - CivicPACE with third-party ownership
 - Third-party ownership under a utility-contracted payment for services agreement



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Upcoming Webinar

- **The Value Proposition for Energy Storage at the Sterling Municipal Light Department**
Thursday, April 27, 2-3:30pm ET

www.cleangroup.org/webinars