RESILIENTPOWER

A project of CleanEnergyGroup

Resilience for Free

October 29, 2015

Seth Mullendore & Rob Sanders
Clean Energy Group

Henry Misas
Bright Power

CleanEnergyGroup
Innovation in Finance, Technology & Policy

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.cleanegroup.org/ceg-projects/resilient-power-project/webinars/

and at

vimeo.com/channels/resilientpower

Today's Speakers

- **Rob Sanders**, Senior Finance Director, Clean Energy Group
- **Seth Mullendore**, Project Manager, Clean Energy Group
- **Henry Misas**, Senior Project Engineer, Bright Power

CleanEnergyGroup
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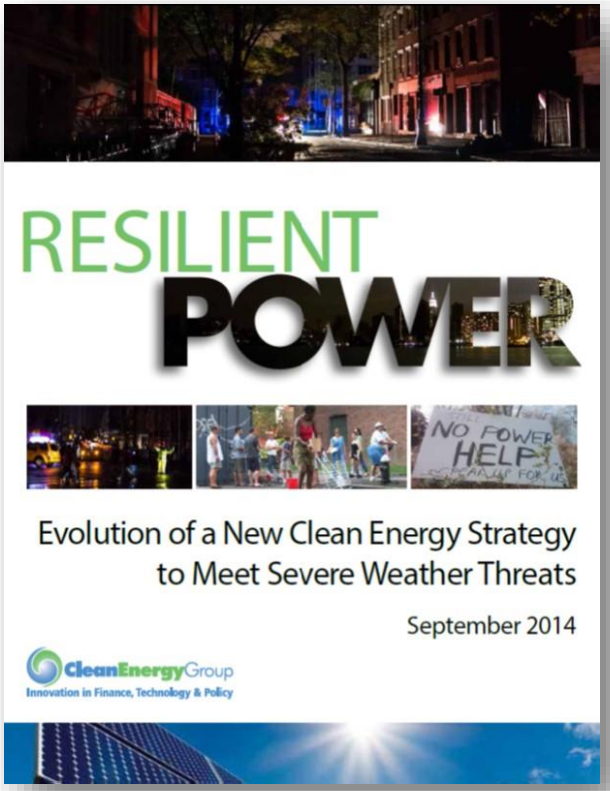
BRIGHT POWER

About Clean Energy Group

Clean Energy Group is a leading national, nonprofit, advocacy organization working on innovative technology, finance, and policy programs in the areas of clean energy and climate change. Clean Energy Group also manages the Clean Energy States Alliance, a coalition of state and municipal clean energy funds.

For more information about Clean Energy Group, visit www.cleanegroup.org.

Who We Are



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Meridian Institute
Connecting People to Solve Problems

CleanEnergy States Alliance

THE JPB FOUNDATION

THE KRESGE FOUNDATION

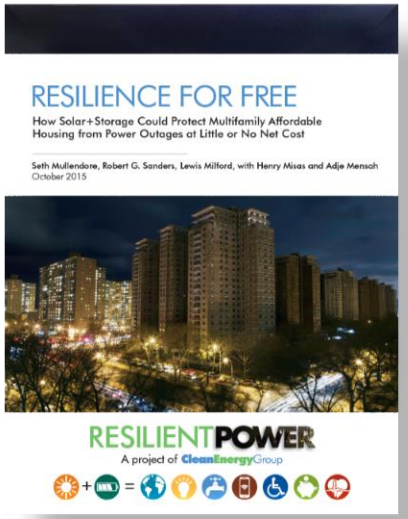
Sandia National Laboratories

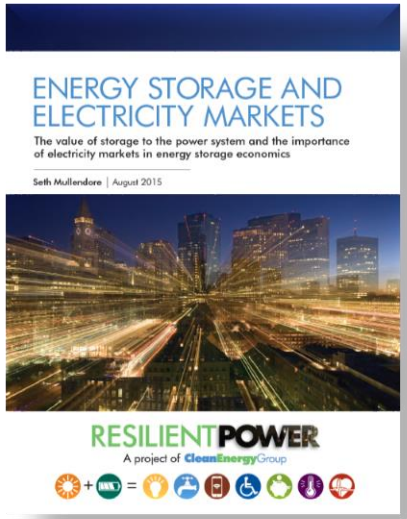
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

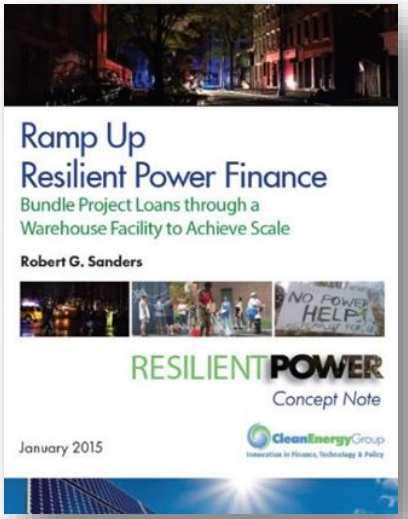
SURDNA FOUNDATION
Fostering sustainable communities in the United States

Resilient Power Project

- Increase public/private investment in clean, resilient power systems
- Engage city officials to develop resilient power policies/programs
- Protect low-income and vulnerable communities
- Focus on affordable housing and critical public facilities
- Advocate for state and federal supportive policies and programs
- Technical assistance for pre-development costs to help agencies/project developers get deals done
- See www.resilient-power.org for reports, newsletters, webinar recordings



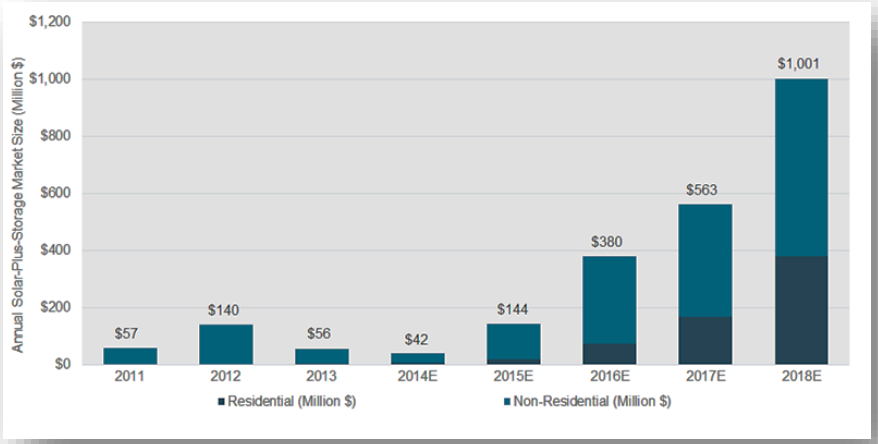




Solar+ Storage New Major Market Trend—Finance Industry

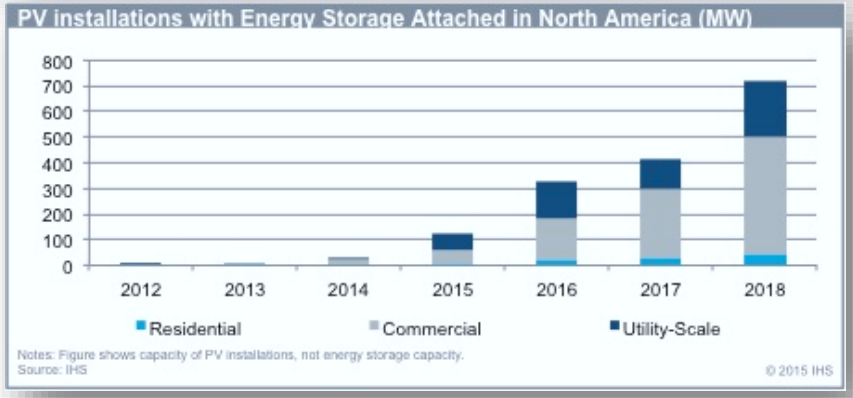
"In 2014, a chorus of analyses from major financial institutions—including Bank of America, Barclays, Citigroup, Fitch Ratings, Goldman Sachs, Morgan Stanley, and UBS—found that solar-plus-battery systems pose a real and present threat to traditional utility business models."

https://cleantechnica.com/2015/04/16/solar-plus-storage-is-coming-to-ders-says-finance-industry/



US Solar-Plus-Storage Market to Surpass $1 Billion by 2018

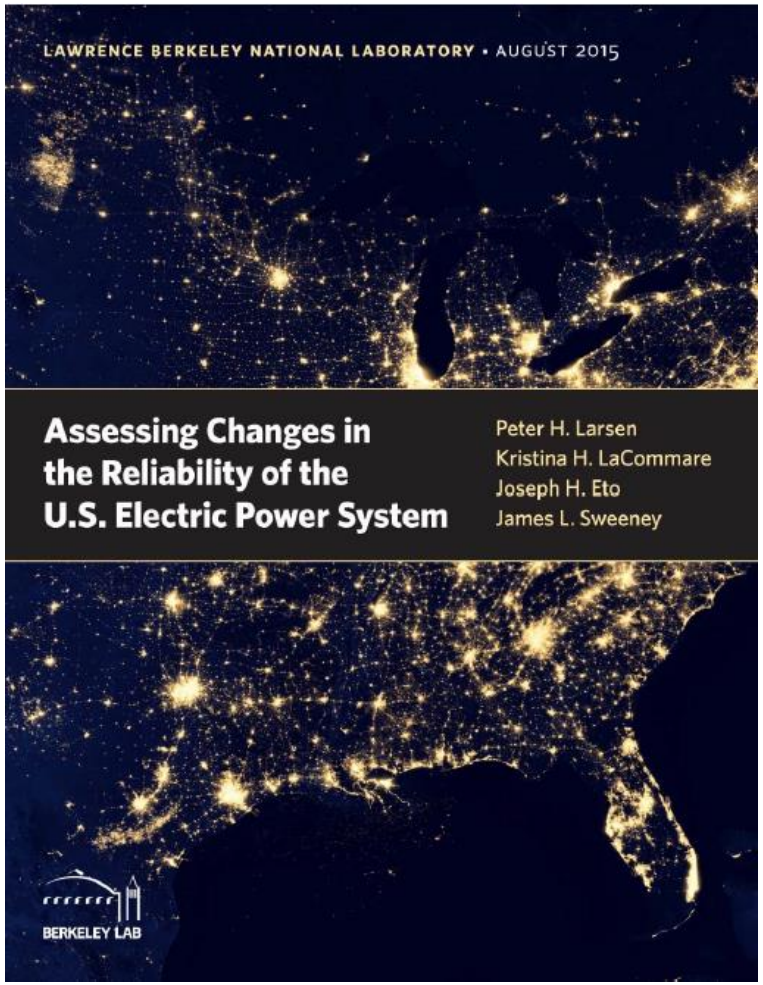
http://www.greentechmedia.com/articles/read/US-Solar-Plus-Storage-Market-to-Surpass-1-Billion-by-2018



IHS: 9% of solar PV systems will have attached storage in 2018

http://www.utilitydive.com/news/ihs-9-of-solar-pv-systems-will-have-attached-storage-in-2018/375636/

Electricity Outages on the Rise



Lawrence Berkley National Laboratory:

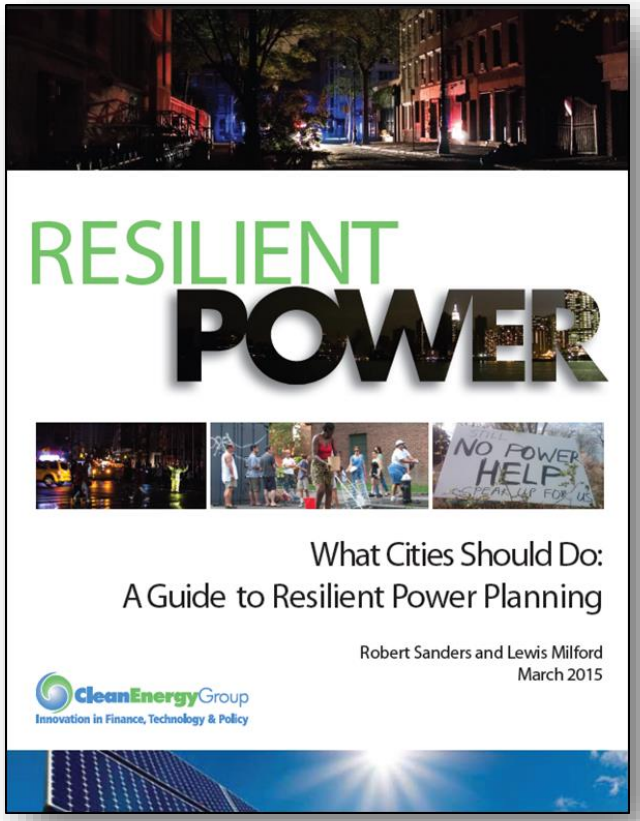
- U.S. electric power system *reliability getting worse over time* due to increase in the number and severity of major weather events
- Frequency of interruptions increasing by *more than 1% per year*
- Average duration of interruptions increasing by *more than 9% per year*

Extreme Weather Disproportionately Hurts Vulnerable & Low-Income Communities

- Extreme weather events harms low-income, elderly and disabled populations disproportionately
- Flooded counties had households at 14% below US median income.
- Drought & heat waves affected counties with households at 5% below US median income.

- **Hurricane Sandy:** 110 US fatalities and $42+ billion in property damage - costliest U.S. hurricane.
- 600,000 people live in 6 low-lying, mostly NY minority communities of South Bronx, Newtown Creek, Brooklyn Navy Yard, Red Hook, Sunset Park & Staten Island.
- In Red Hook (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.
- No backup generators at senior centers.

Resilient Power Inequality



The challenge for our country now is to bend the technology trend for solar+storage systems to serve public needs, such as affordable housing and other essential services in low-income communities.

http://www.cleanegroup.org/assets/2015/Resilient-Cities.pdf

Public Support for Solar+Storage

Public Investments:

- **Connecticut** DEEP: **$48 Million**
- **New Jersey** BPU: **$200 Million** Energy Resilience Bank and **$10 Million** Energy Storage Program
- **Massachusetts** DOER: **$40 Million** Community Clean Energy Resiliency **New York** NYSERDA: **$40 Million** NY Prize microgrids, **$66 Million** CHP

TOTAL: >$400 million in new NE state funds alone in last 18 months

Resilient Solar+Storage Projects to Date:

- **New Jersey** BPU: $3 million for 13 solar+storage projects at schools, wastewater treatment plants. **Total : $12 million;** State investment for round two: **$6 million**
- **Massachusetts** DOER: $26 million for 21 municipal projects, including 31 solar+storage projects at schools, wastewater plants, first responders. **Total project investment: ~$52 million**
- **Vermont** Solar+storage microgrid. **Total project investment: $12.5 million**

TOTAL: ~$76.5 million in solar+storage projects over the past year*

**Results do not include California*

Resilient Power Projects – Housing

- Technical assistance fund: project grants to design and deploy resilient power systems
- Demonstrate viability of clean energy + storage in affordable housing and assisted living
- Working with housing and solar+storage developers in NYC, Chicago, DC, Newark, Boulder
- Via Verde (Bronx) – could be 1st solar+storage project for resilient power applied to affordable housing

Resilient Power Projects – Community Facilities

- Demonstrate viability of clean energy + storage in critical community facilities
  - Community shelters, police and fire stations, hospitals, wastewater treatment
- Working with municipalities to develop resilient power plan for critical facilities
- Municipal solar+storage project planning underway in Baltimore, Salt Lake City, Los Angeles, Duluth, DC

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

RESILIENCE FOR FREE

How Solar+Storage Could Protect Multifamily Affordable Housing from Power Outages at Little or No Net Cost

Seth Mullendore, Robert G. Sanders, Lewis Milford, with Henry Misas and Adje Mensah
October 2015

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Resilience for Free - Findings

- Analysis of project economics in different markets
- Findings:
  - Solar+storage can reduce operating costs
  - Financing can be repaid with electricity market revenues
  - Energy storage can improve economics of stand-alone solar
  - In certain markets, resilient solar+storage can be developed at little to no net cost over the life of the project
    - Essentially resilience for free
  - Many financing gaps, no standardized system applications, no performance track record for credit underwriting, high cost of one-off projects
  - At this stage in market, incentives & policies make a difference in getting projects done

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Economic Drivers for Solar+Storage and Analysis of Three Projects

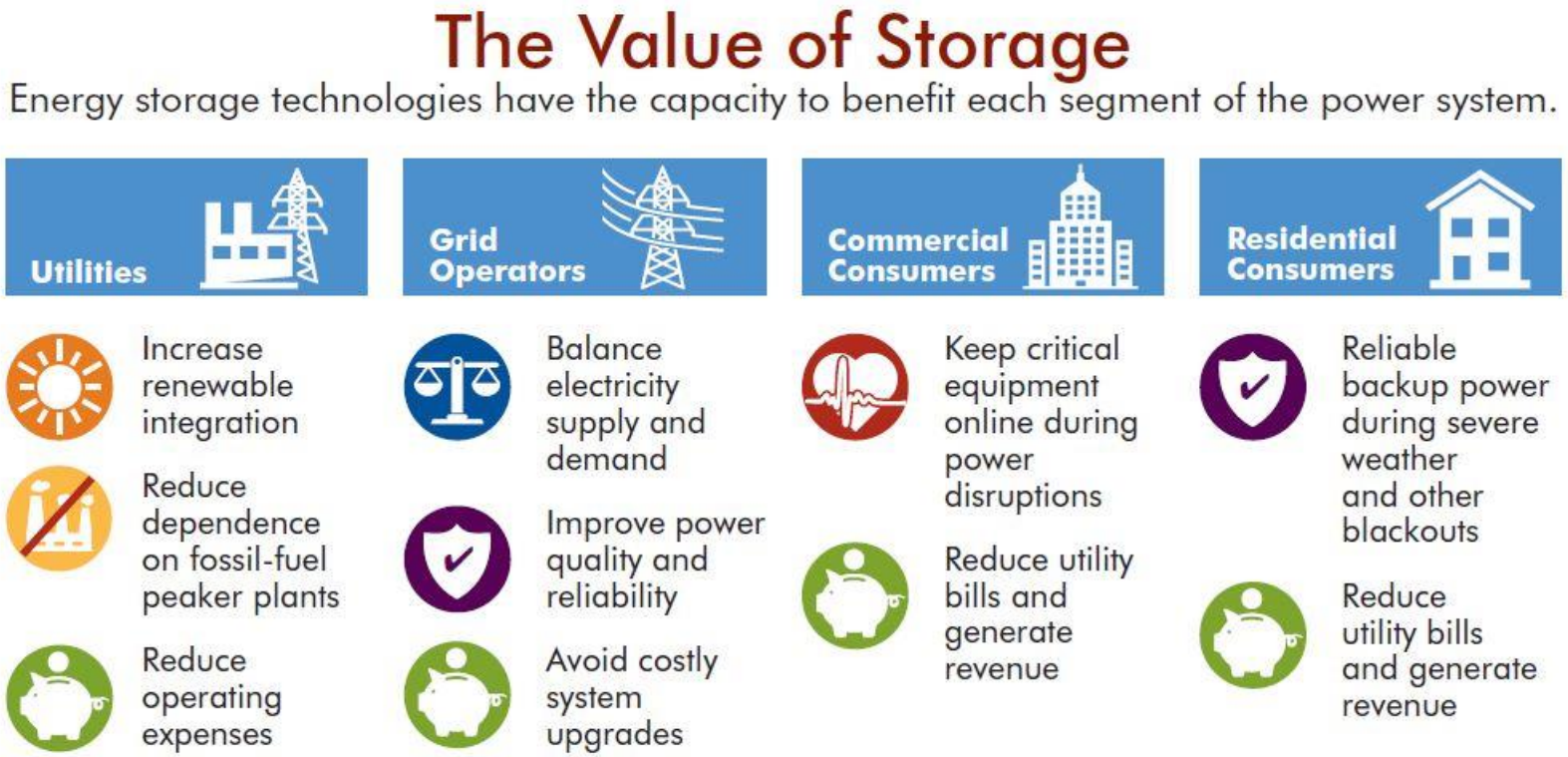
October 29, 2015

Seth Mullendore
Project Manager
Clean Energy Group

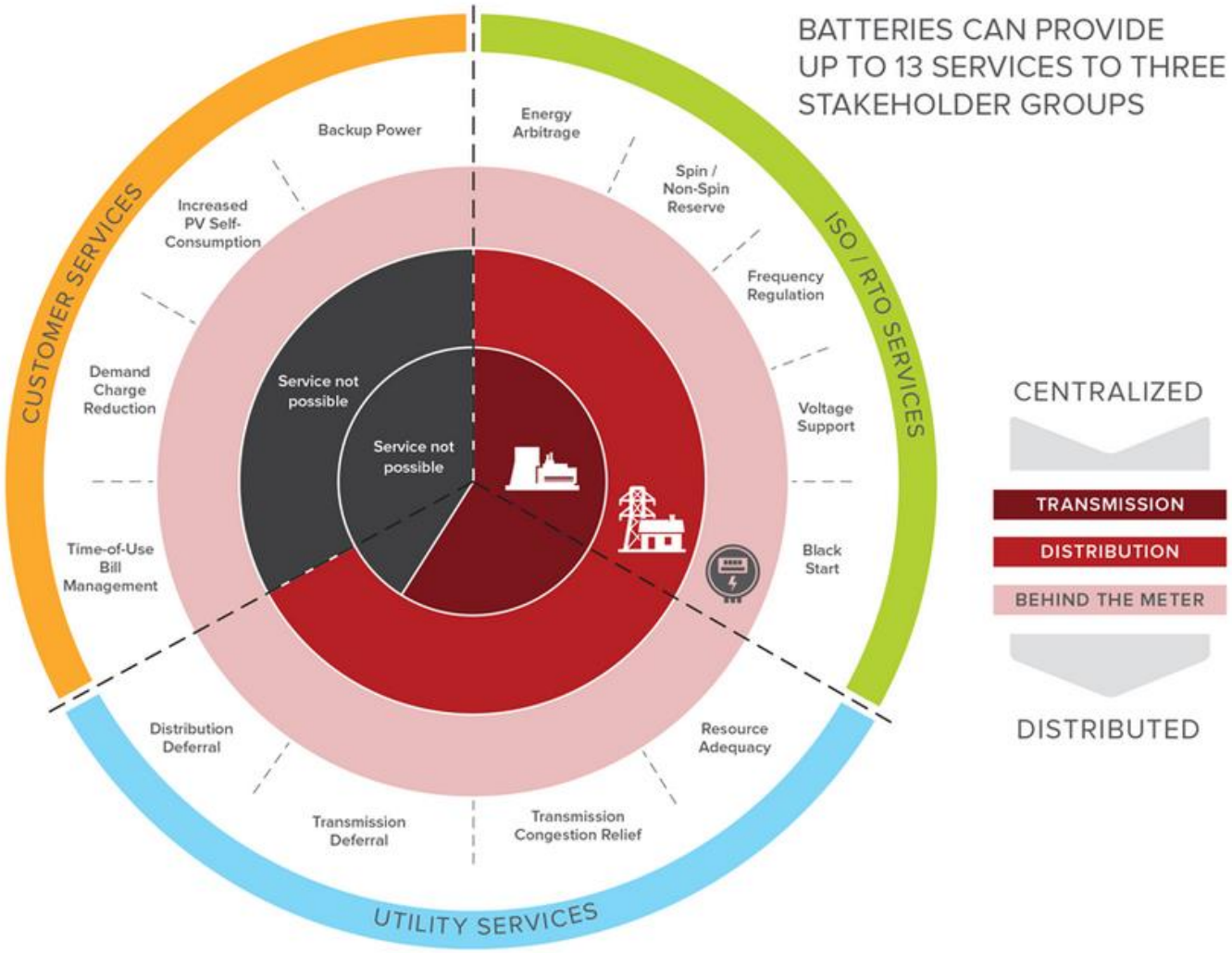
Value of Solar

- **Offset electricity consumption (kWh)**
- **Solar Renewable Energy Certificates (SREC)**
- **Incentives**
  - Federal Investment Tax Credit (ITC)
  - State and local incentives

Value of Battery Storage

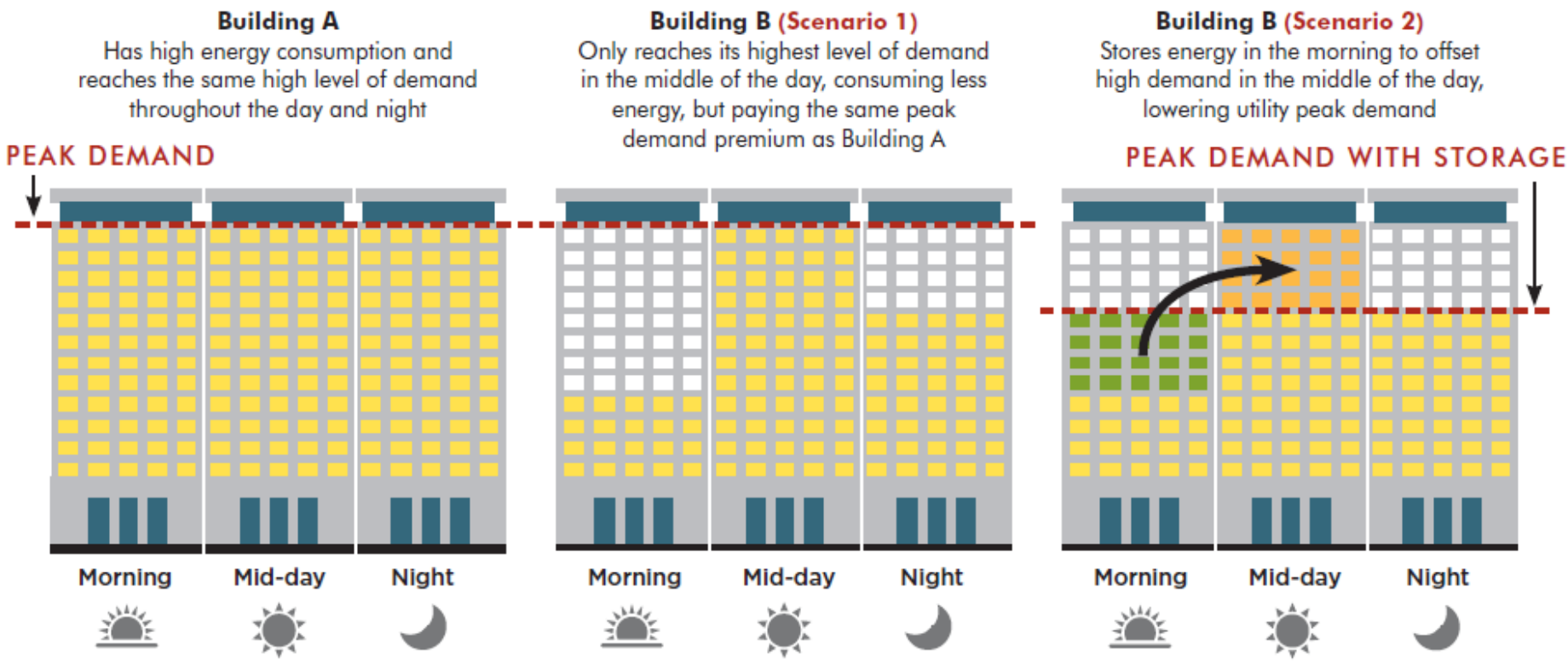


Value: Location, Location, Location



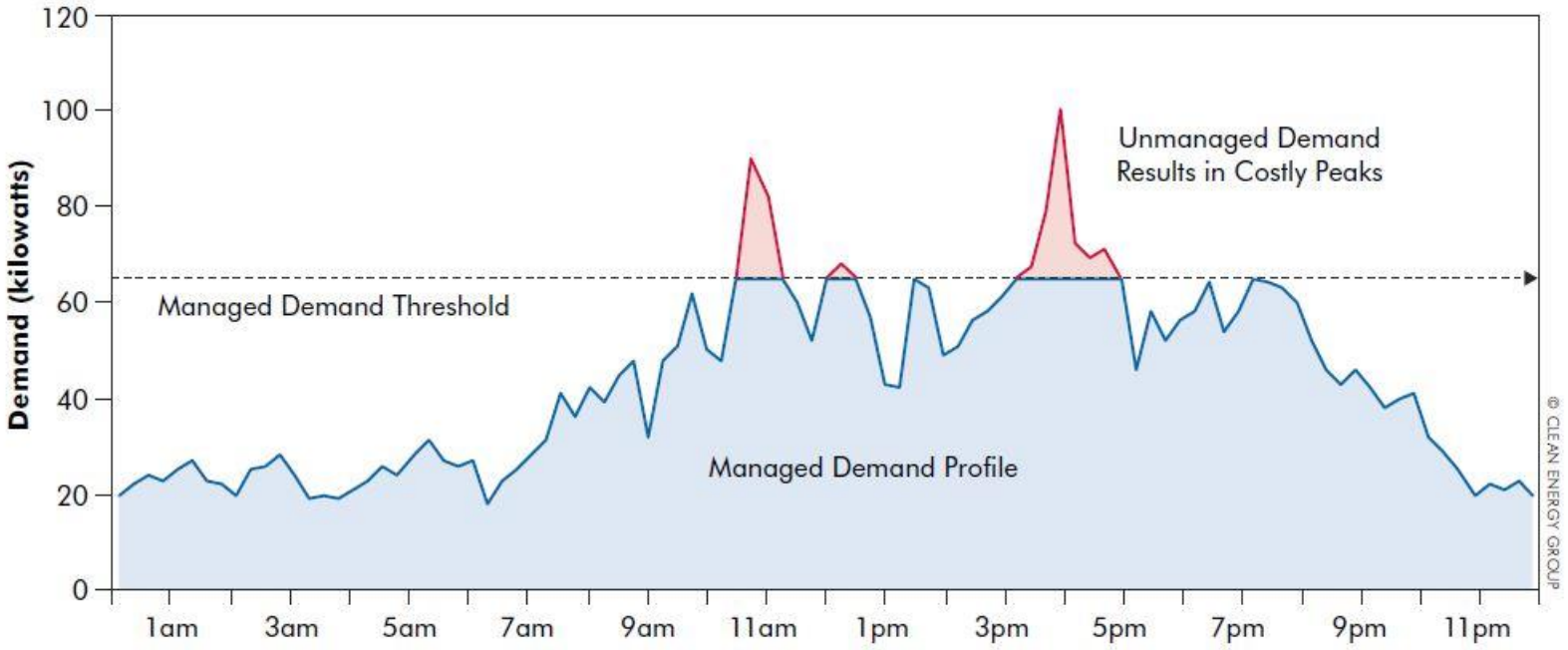
Source: RMI "The Economics of Battery Energy Storage"

Customer Value: Demand Management



In **Scenario 1**, Building A and Building B will incur the same peak demand charges over the course of the day, even though Building A will have consumed considerably more energy during that time. In **Scenario 2**, Building B can use energy storage to reduce its mid-day grid energy consumption by meeting some of its demand with on-site stored energy. **This could reduce its overall peak demand** for the period, resulting in a lower utility bill.

Customer Value: Peak Shaving



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

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

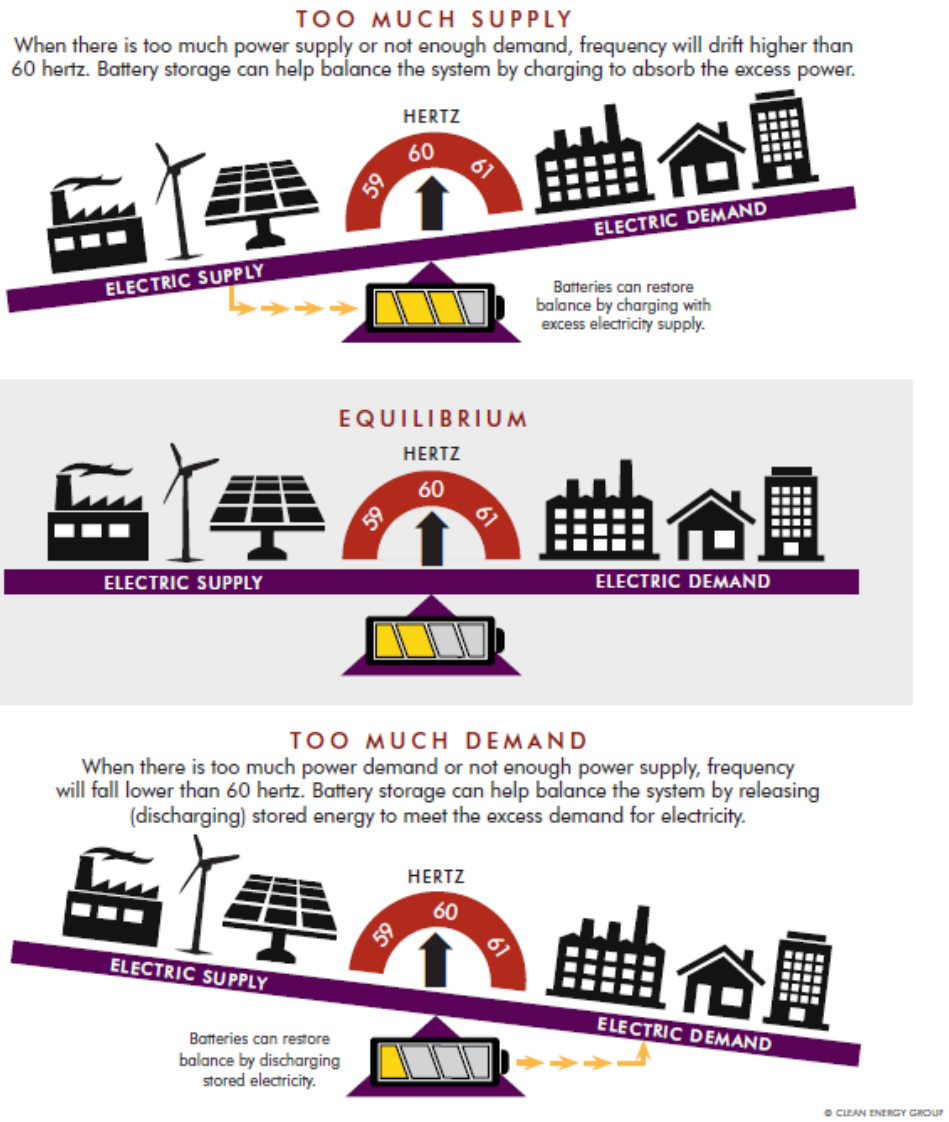
@ $20/kW = **$8,400 annual savings**

Utility/Grid Value

- **Demand response**
- **Power system reliability**

Ancillary Services	
Frequency regulation	Balancing of electricity supply and demand to keep frequency within operational bounds. Includes services for responding to both increases and decreases in system frequency.
Spinning reserve	Generation capacity that is connected to the power system but not generating electricity until needed, with the ability to respond immediately, within 10 minutes.
Non-spinning reserve	Generation capacity that is not connected to the system but can be brought online after a brief delay.
Voltage control	Similar to frequency regulation but using reactive power to maintain proper transmission system voltage.
Black start	Ability to restore power to part of the grid after failure occurs.

Utility/Grid Value: Frequency Regulation



Analysis of Three Projects: Chicago, IL

ANALYSIS MODEL NO. 1

Chicago, Illinois

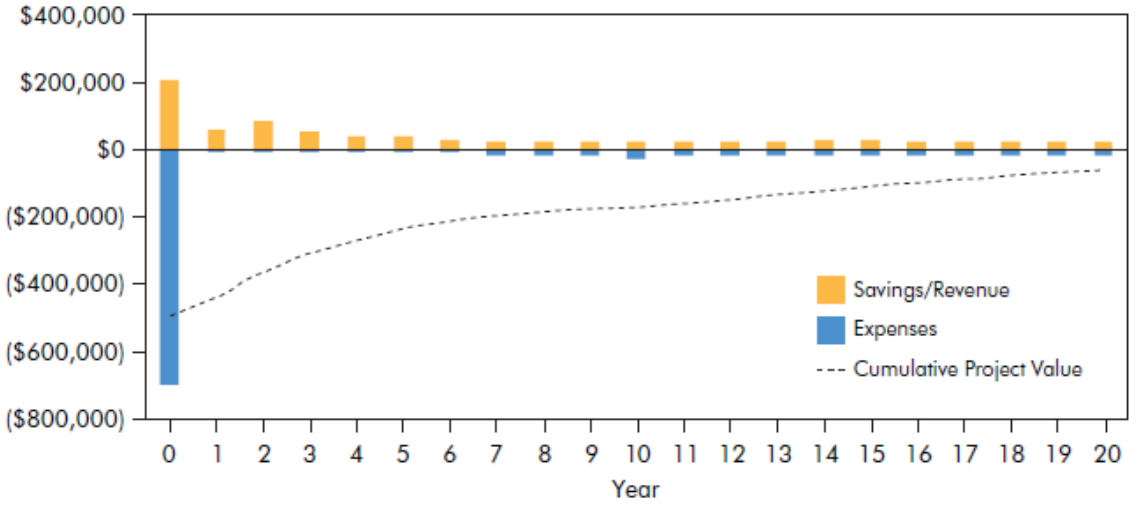
Chicago Project Summary			
System Size	200-kW solar-only	200-kW solar +100-kW/ 50-kWh lithium-ion battery	200-kW solar + 300-kW/ 150-kWh lithium-ion battery
Initial Cost*	$493,000	$606,000	$832,000
Payback Period	20+ years	11.8 years	6.2 years

* Initial project costs refer to year zero net project expenses after federal tax credits and any additional tax credits have been applied.

Analysis of Three Projects: Chicago, IL

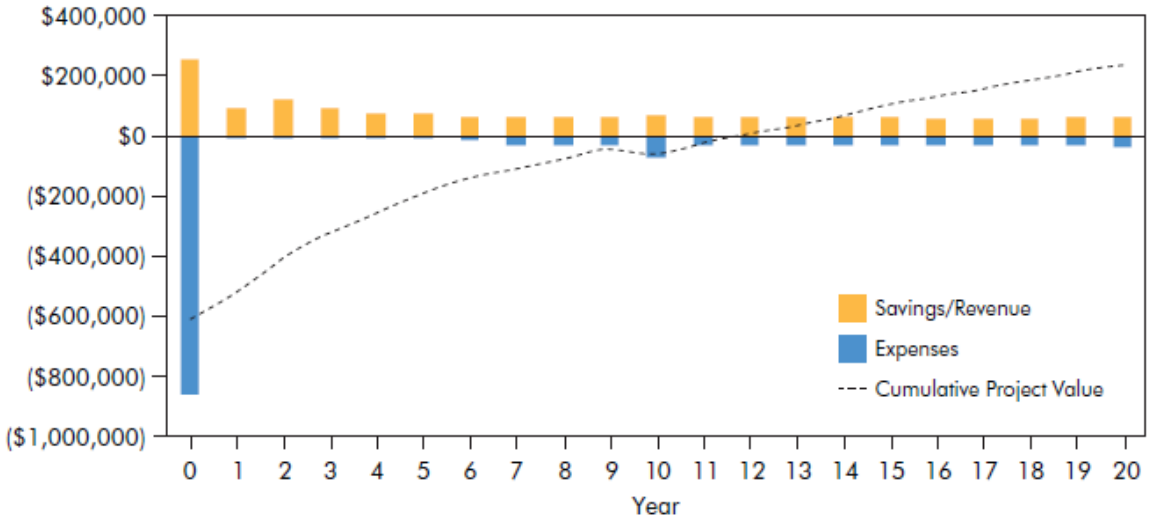
200 kW
solar-only

20+ year payback



200 kW solar +
100 kW/50 kWh
lithium-ion battery

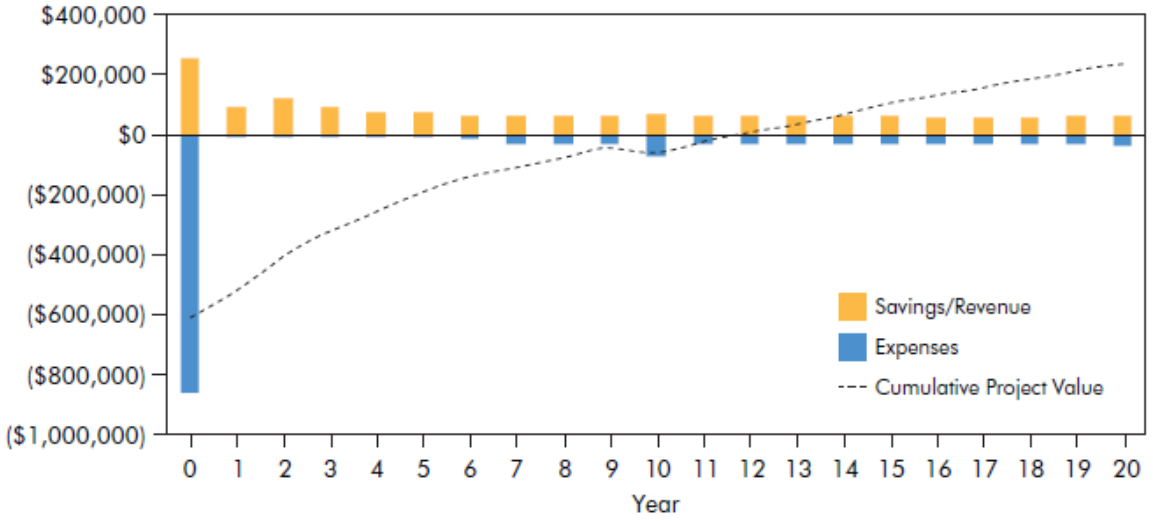
11.8 year payback



Analysis of Three Projects: Chicago, IL

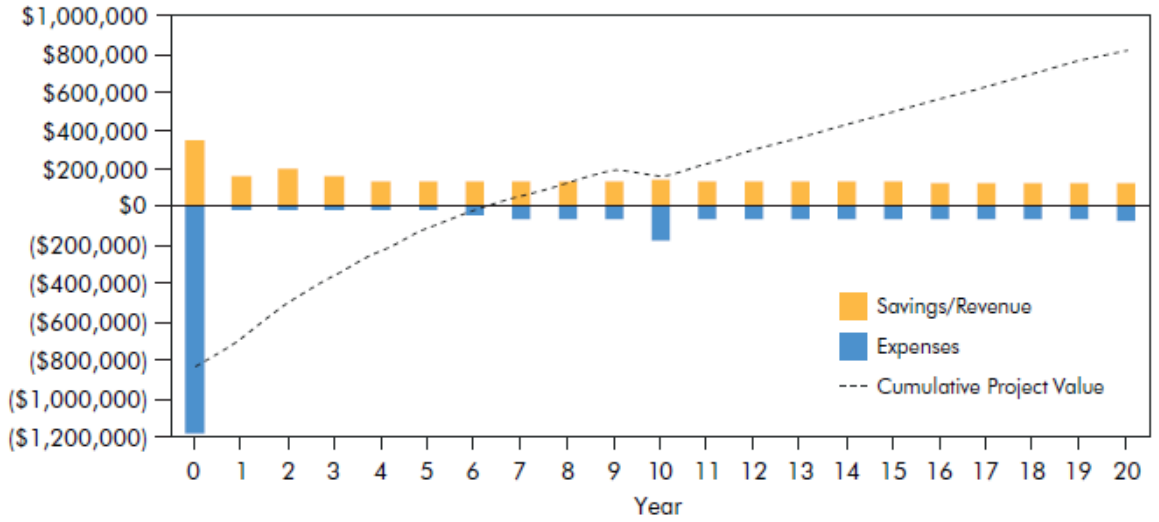
200 kW solar +
100 kW/50 kWh
lithium-ion battery

11.8 year payback



200 kW solar +
300 kW/150 kWh
lithium-ion battery

6.2 year payback



Analysis of Three Projects: Washington, D.C.

ANALYSIS MODEL NO. 2

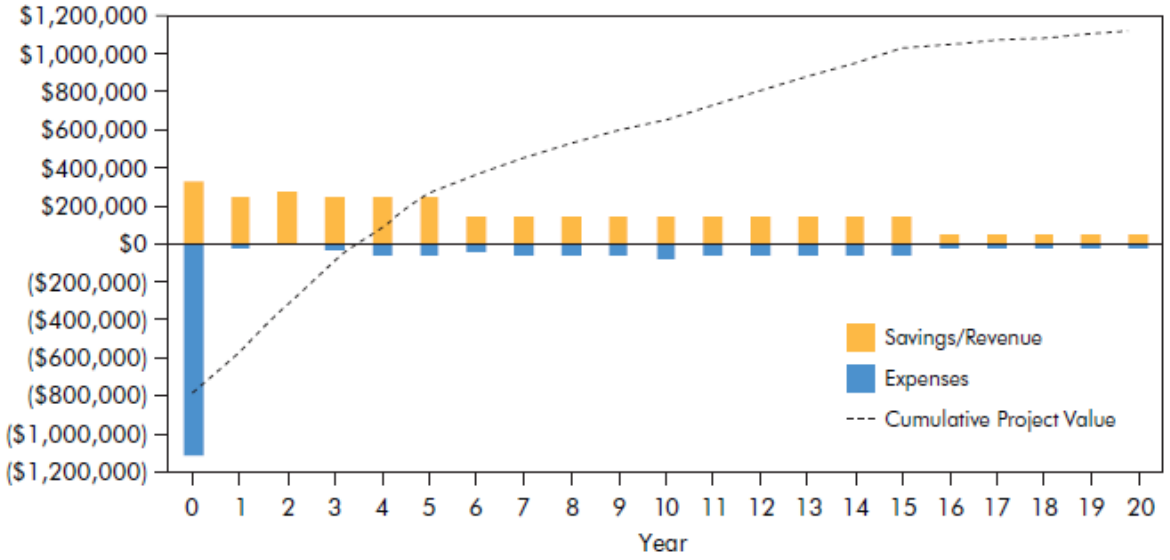
Washington, D.C.

Washington, D.C. Project Summary		
System Size	360-kW solar-only	360-kW solar +100-kW/ 50-kWh lithium-ion battery
Initial Cost	$788,000	$901,000
Payback Period	3.5 years	3.5 years

Analysis of Three Projects: Washington, D.C.

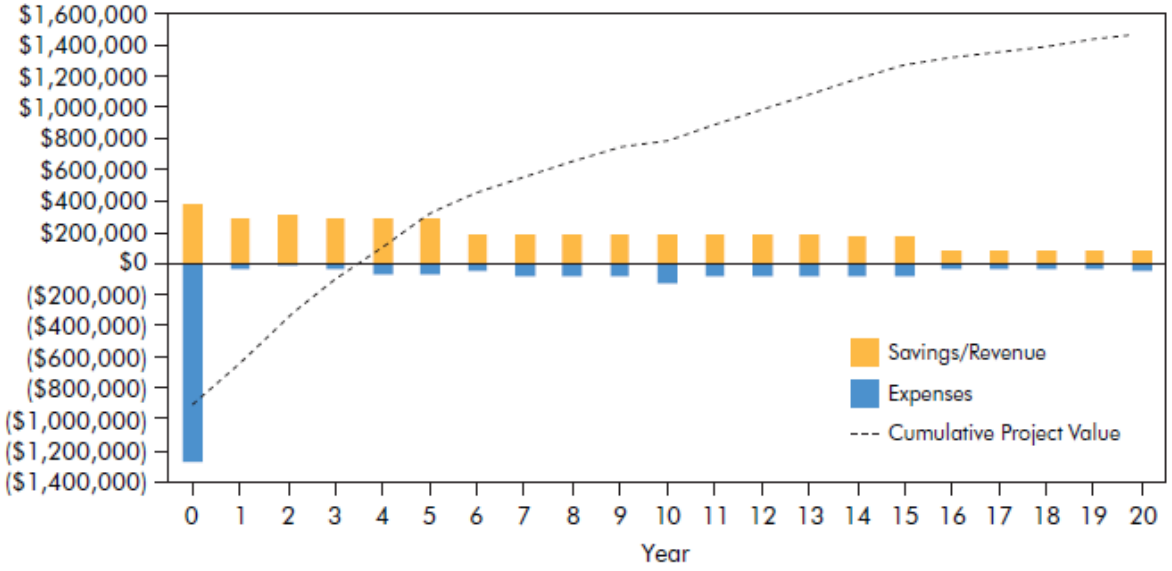
360 kW solar-only

3.5 year payback



360 kW solar + 100 kW/50 kWh lithium-ion battery

3.5 year payback



Analysis of Three Projects: New York City

ANALYSIS MODEL NO. 3

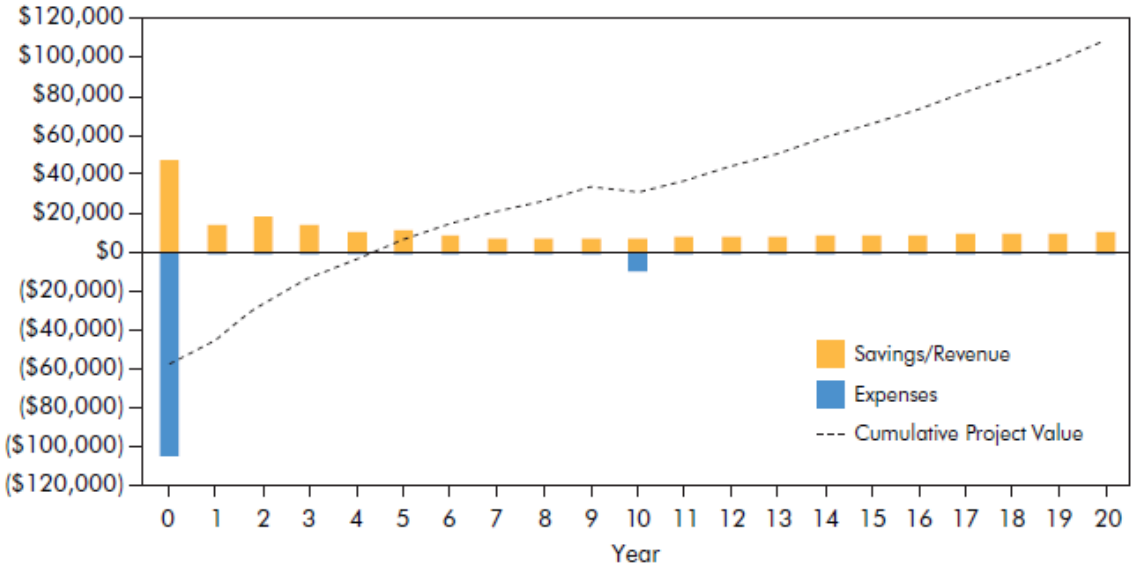
New York City

New York City Project Summary		
System Size	30-kW solar-only	30-kW solar + 30-kW/ 60-kWh lead-acid battery
Initial Cost	$58,000	$128,000
Payback Period	4.3 years	14.2 years

Analysis of Three Projects: New York City

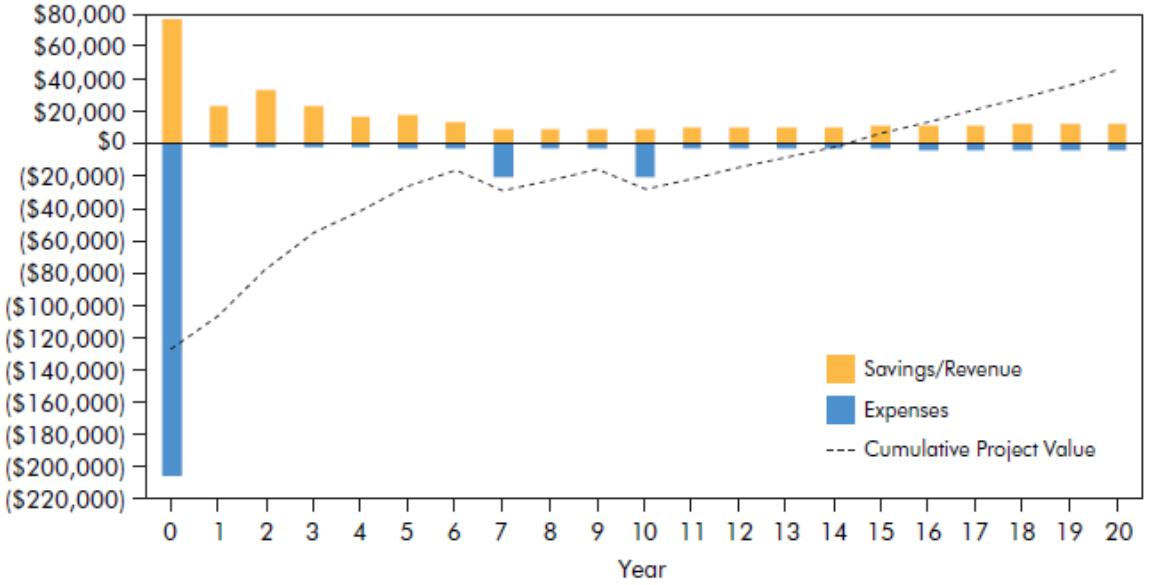
30 kW
solar-only

4.3 year payback



30 kW solar +
30 kW/60 kWh
lead-acid battery

14.2 year payback



Resilient Solar+Storage Incentives

- States like NY may need a targeted incentive to encourage resilient solar+storage deployment
- Incentive should be set high enough to encourage development and decline as market matures (SGIP)
- Limit time and discharge constraints (Con Edison)
- Priority to projects in low-income areas, facilities supporting vulnerable communities

Contact Information

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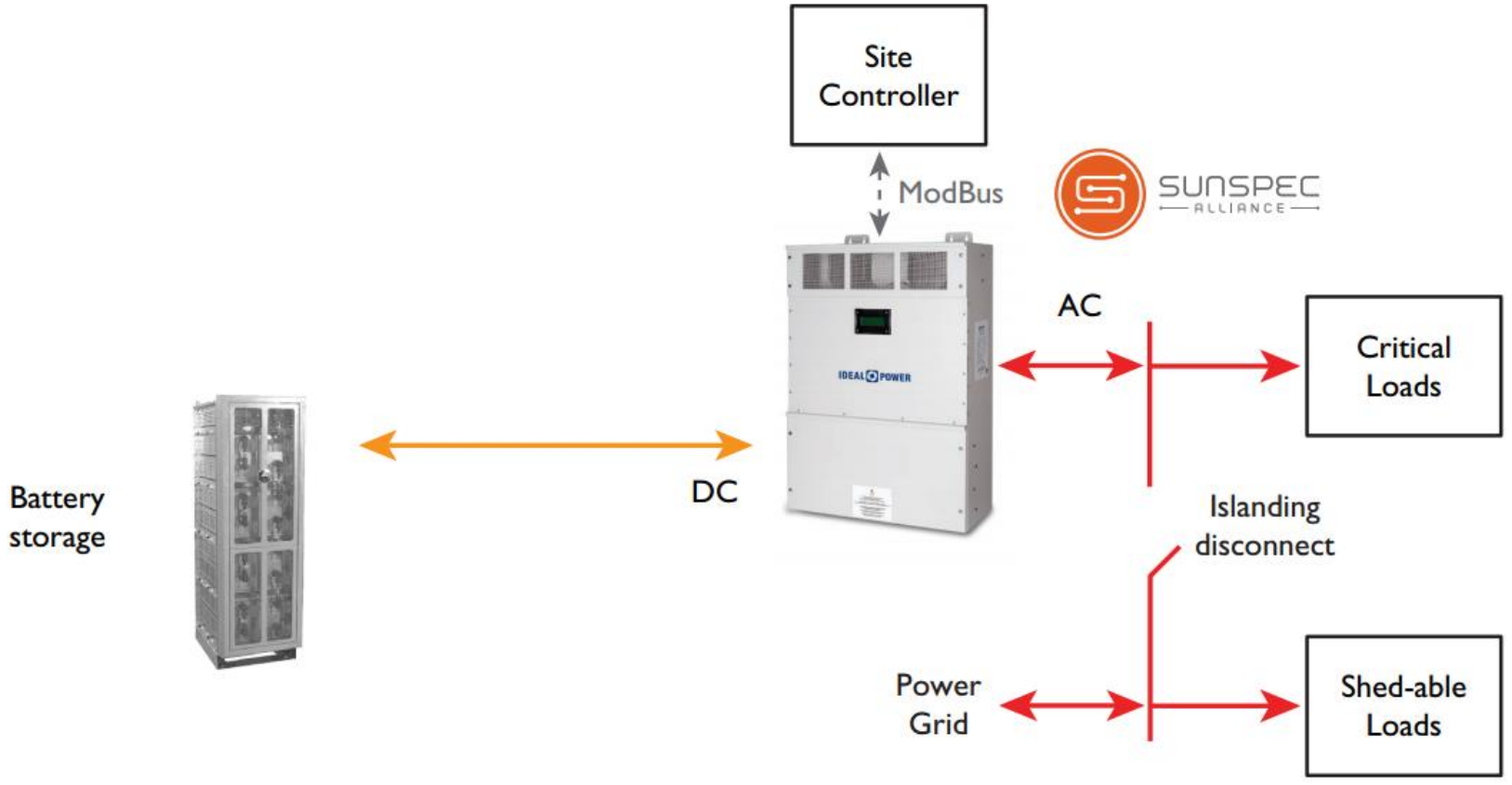
Solar + Storage Applications for Multifamily Housing

October 29, 2015

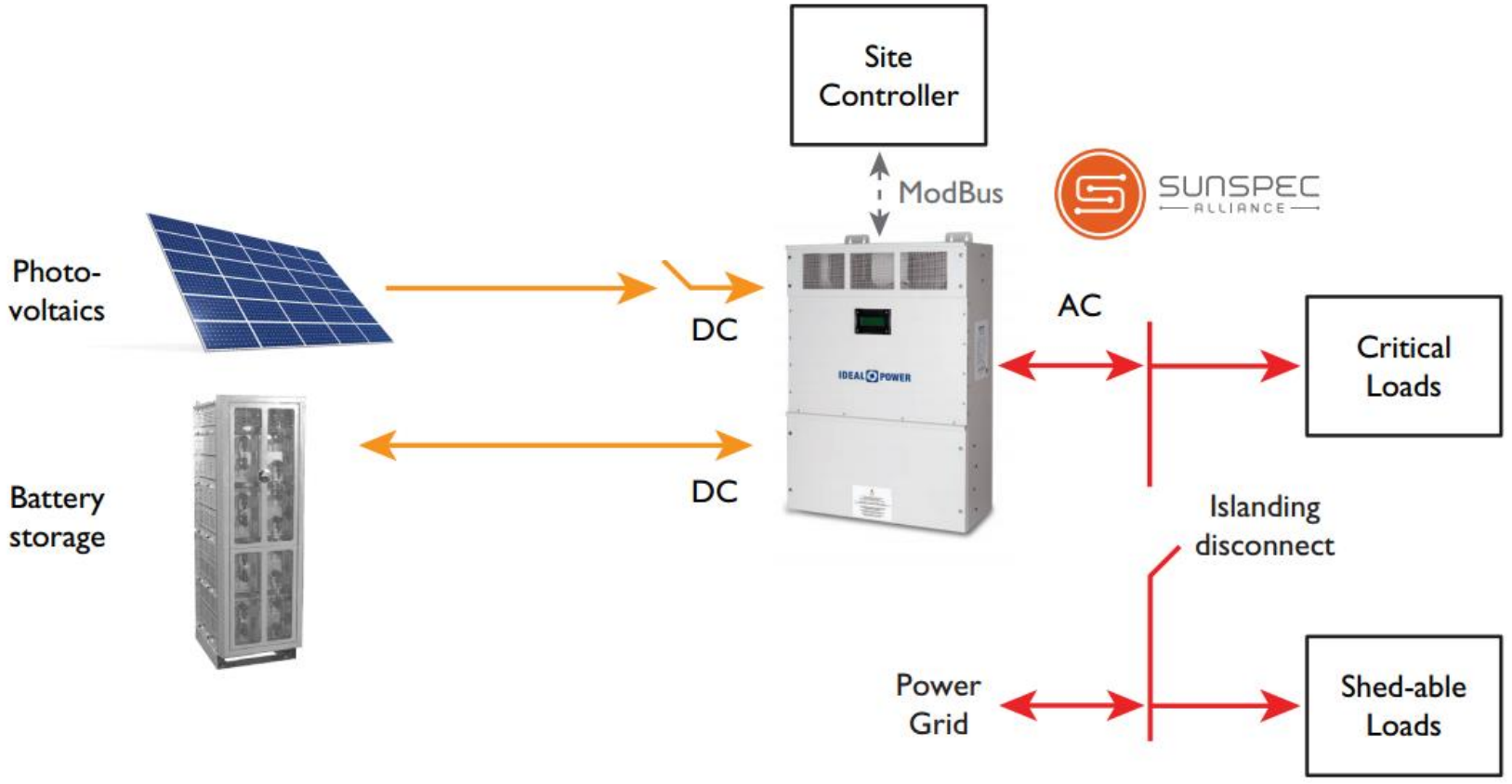
Henry Misas
Sr. Project Engineer
Bright Power

Battery-Based Building Microgrid



Ideal Power

Hybrid Solar+Storage Building Microgrid

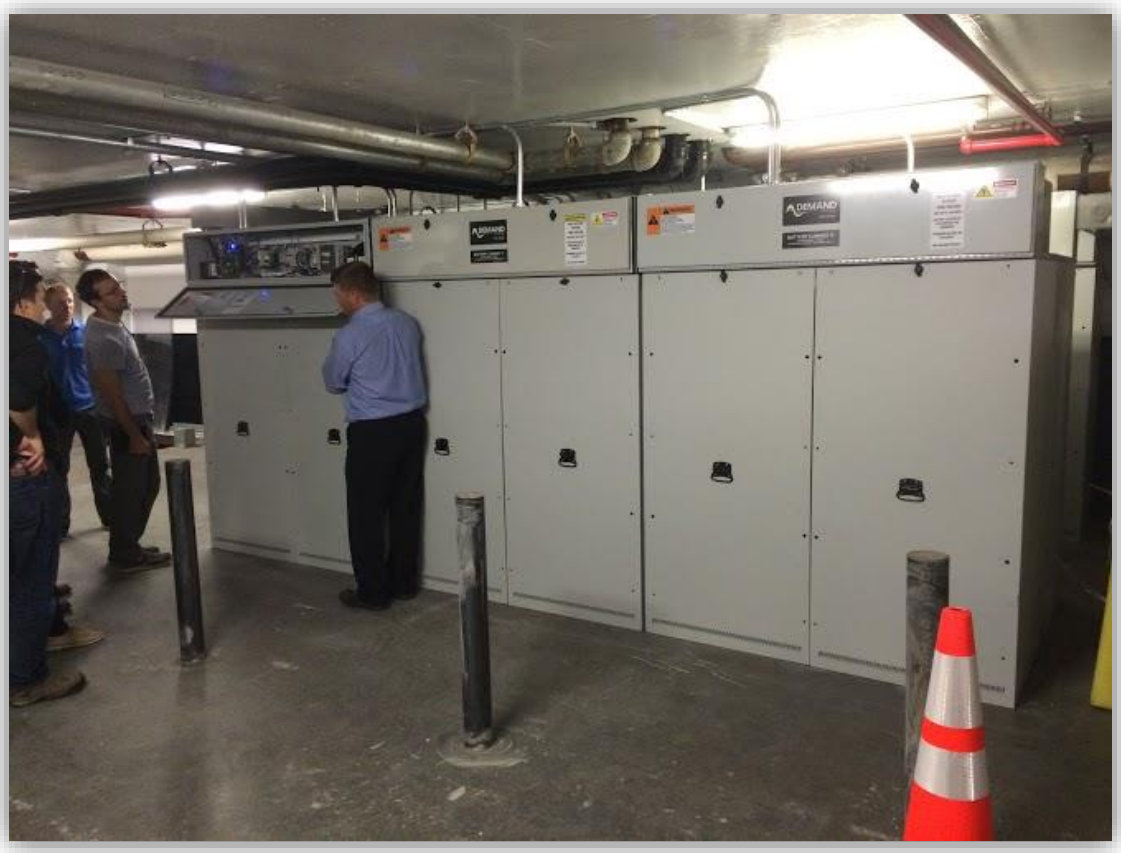


Ideal Power

Grid-Tied Energy Storage Solutions

100 kW / 400 kWh
Joule.System
Demand Energy Networks

Grid-Tied Energy Storage



Demand Energy Networks

Grid-Tied Energy Storage

Demand Energy Networks

Bulk Energy Storage

Aquion Energy
14 to 28 kWh

GS Battery – 48 kWh
Lead Acid (VRLA)

High Rate Discharge Energy Storage

Samsung SDI (Younicos)

LG Chem – 45 kWh
Lithium Nickel Manganese Cobalt (NMC)

CODA Energy – 50 kWh
Lithium Iron Phosphate

Backup Power Technologies

Gexpro Power IQ

Caterpillar

- Inverter controlled storage
  - Faster response than combustion generation
  - No exhaust/emissions, no moving parts
  - Batteries need to be recharged
- Combustion Generator
  - Lower installed cost per Watt
  - Longer duration if fuel is available
  - Less reliable if not used regularly

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Sign up for the RPP e-Distribution List to get notices of future webinars and the monthly *Resilient Power Project Newsletter*: http://bit.ly/RPPNews-Sign-UP

More information about the Resilient Power Project, its reports, webinar recordings, and other resources can be found at www.resilient-power.org.

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