

# RESILIENT



# POWER

A Project of **Clean Energy Group**

## Clean Energy Group Webinar: Financing Resilient Power

November 20, 2014

Rob Sanders, Clean Energy Group  
Henry Misas, Bright Power, Inc.



# 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.cleangroup.org/ceg-projects/resilient-power-project/webinars/](http://www.cleangroup.org/ceg-projects/resilient-power-project/webinars/)

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[vimeo.com/channels/resilientpower](http://vimeo.com/channels/resilientpower)

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# Who We Are



**RESILIENT  
POWER**

Evolution of a New Clean Energy Strategy  
to Meet Severe Weather Threats

September 2014

[www.resilient-power.org](http://www.resilient-power.org)  
[www.cleangroup.org](http://www.cleangroup.org)

# History of CEG and Resilient Power

THE NEW YORK TIMES OP-ED TUESDAY, JULY 13, 1999

## The Lesson Hidden In the Blackout

By Lewis Milford

COLUMBIA, Va. — Researchers at Columbia University are trying to figure out what crucial material they may have lost when some of their backup generators didn't work during last week's power blackout.

This sad state of affairs should prompt the rest of us to confront a simple truth: our 19th-century electricity system is not suited for 21st-century needs. If we are to prevent similar critical failures in the future, we must look over for smarter energy solutions.

Some companies already have a head start. The First National Bank of Omaha has stopped using electricity from the grid — the interconnect system from which almost everyone gets electricity — as its primary power source. It is now producing its own energy and is using the grid only as a backup. First National, the largest privately held bank in the country, runs the seventh-largest credit card processing operation. The bank needs to be able to crunch large amounts of data 24 hours a day, seven days a week.

That's why the bank has purchased its own system of four fuel cells, which, like batteries, create energy through a chemical process instead of by burning fossil fuels. They are so clean that they are exempt from most air pollution rules.

The bankers aren't doing this because they are environmental activists. The real value of the fuel cell system is that it's nearly 100 percent reliable.

The bank competes with other companies for credit card business. The more time its computers can keep running, the more credit card transactions it can process — and the more business it can attract. Fuel cells can run almost all the time without interruption, allowing computers to operate constantly without crippling breakdowns.

According to industry statistics, a typical bank of corporate computers experiences nearly 200 power interruptions of one kind or another each year. American businesses lose an estimated \$20 billion a year from these failures. And in cases like the damage to the research materials at Columbia, there is no way to put a price on potential losses to science.

Lewis Milford is president of Clean Energy Group, a nonprofit group.

and public health. These problems will only get worse. The growing number of desktop computers and data centers running the Internet will increase the demand for high-quality power sources. As a result, computer-grade energy may soon add up to nearly 10 percent of demand for electricity, a figure that will only increase with greater Internet activity.

Most companies spend billions of dollars on backup power systems, batteries or diesel generators to keep their computers running smoothly. These systems are necessary because the power system can be quite unreliable. But such stopgap measures can't supply the guaranteed power that computers or other sensitive electric loads need. The New York power blackout proved that.

Some of the nation's largest emergency generators weren't adequate. First National Bank of Omaha isn't the only company that has turned to fuel-cell technology. Other companies, including hospitals, universities, computer chip makers — virtually any critical city service that relies on electricity — are turning to fuel cells. Just last week, before the blackout, Harvard University's computer center was using fuel cells to power its lab shutdowns. Harvard



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### Home / Blog / Sandy's Power Outages: We Can, And Should, Do Better

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 Northeast Wind Resource Center (NWRC)

November 16, 2012 | by Lewis Milford, CEG  
**Sandy's Power Outages: We Can, And Should, Do Better**  
 Category: Clean Energy Innovation, Resilient Power and Climate | 0 Comments

School began a comprehensive investigation to see if fuel cells could power its teaching and laboratories. The Pew Charitable Trusts has given my organization a grant to help Harvard create a model for the entire health care industry. But the Harvard initiative covers only health care. We need to broaden the use of fuel cells in every industry that needs computer-grade power. This would start to replace our outdated electric system, and would also reduce energy-related pollution including greenhouse gases. Fuel cells are one of the cleanest energy technologies available.

If money or political will or some other excuse is standing in the way of this effort, ask yourself this question: What's the price of losing a child to cancer because an outdated diesel generator failed to work?



I'm looking in disbelief at images of Sandy's destruction in New York and New Jersey. I grew up near the Jersey Shore, so this is personal. It's bad up there: lines for rationed gasoline, homes and businesses destroyed, and millions of people still without electricity.

## ENERGY SECURITY & EMERGENCY PREPAREDNESS

How Clean Energy Can Deliver More Reliable Power for Critical Infrastructure and Emergency Response Missions

An Overview for Federal, State and Local Officials



Prepared by Clean Energy Group

OCTOBER 2005

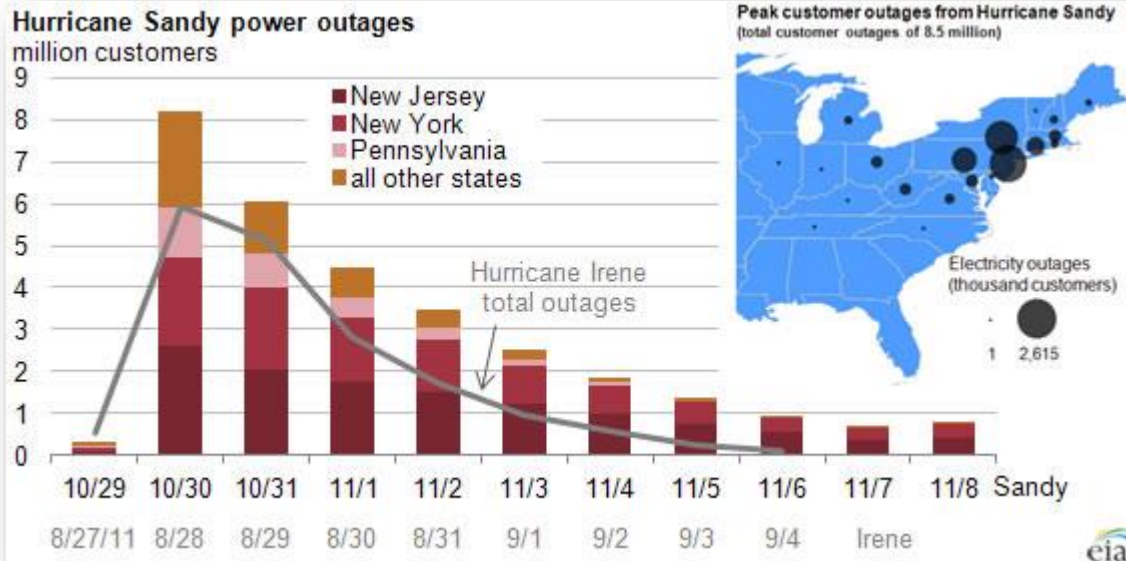
# RESILIENT POWER

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# Sandy and Power

“Extensive power outages during Sandy affected millions of residents and resulted in substantial economic loss to communities. Despite the size and power of Hurricane Sandy, this was not inevitable: resilient energy solutions could have helped limit power outages.”

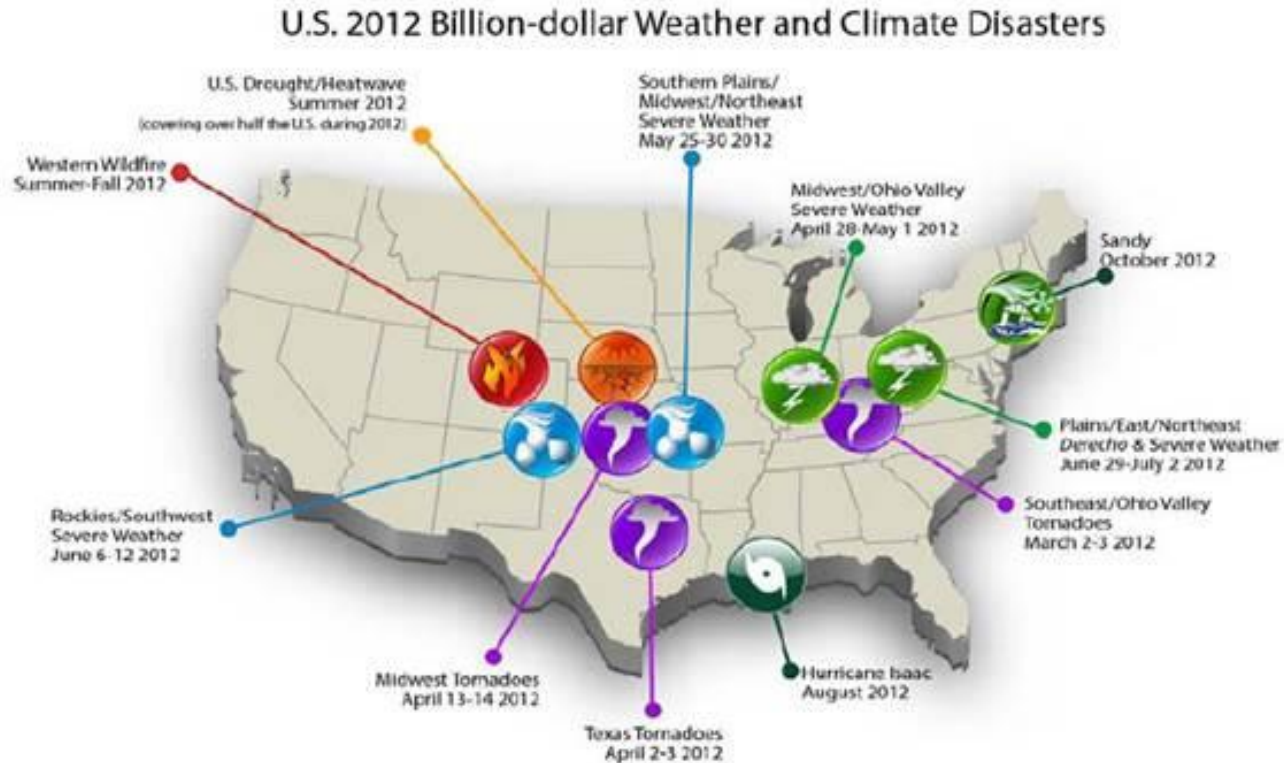
*Hurricane Sandy Rebuilding Strategy:  
Stronger Communities, A Resilient Region (Aug. 2013)*



**“The fact that the NYU hospital is dark but Goldman Sachs is well-lit is everything that’s wrong with this country.”**

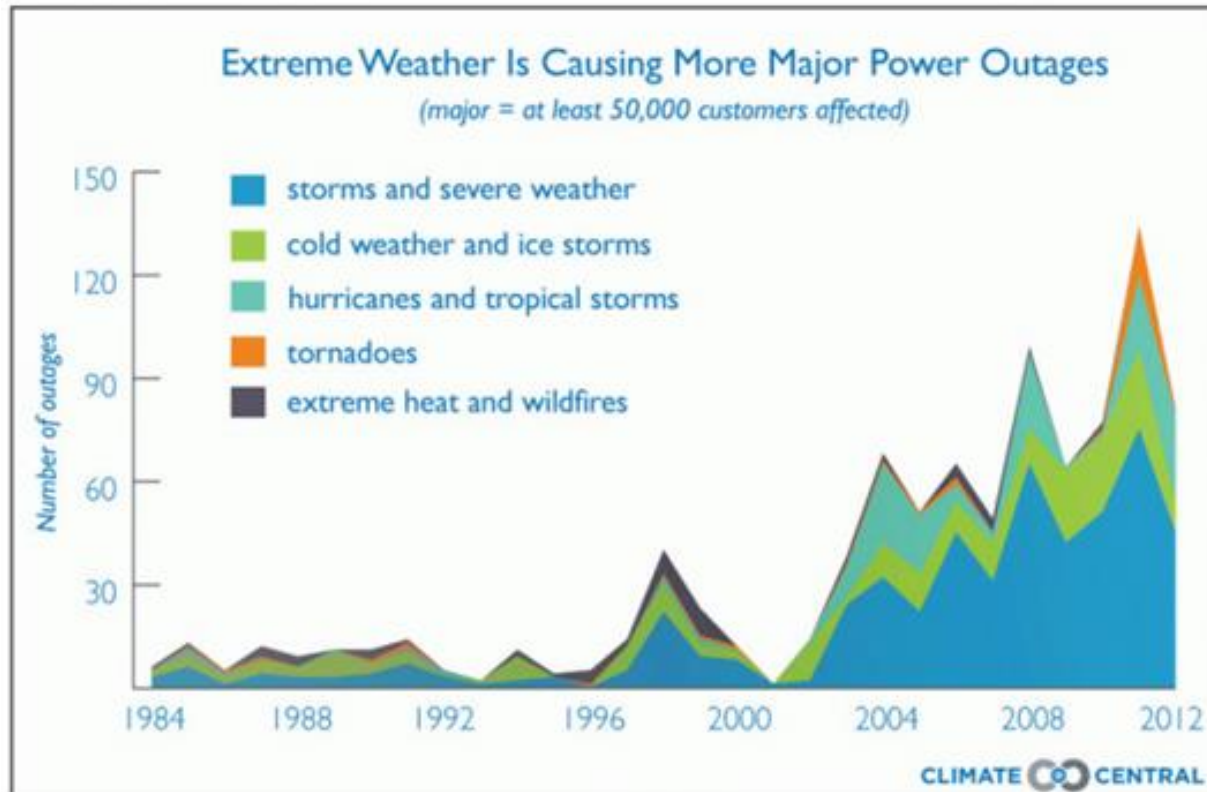


# Extreme Weather Events & Power Outages



Source: National Oceanic and Atmospheric Administration

# Extreme Weather Events & Power Outages

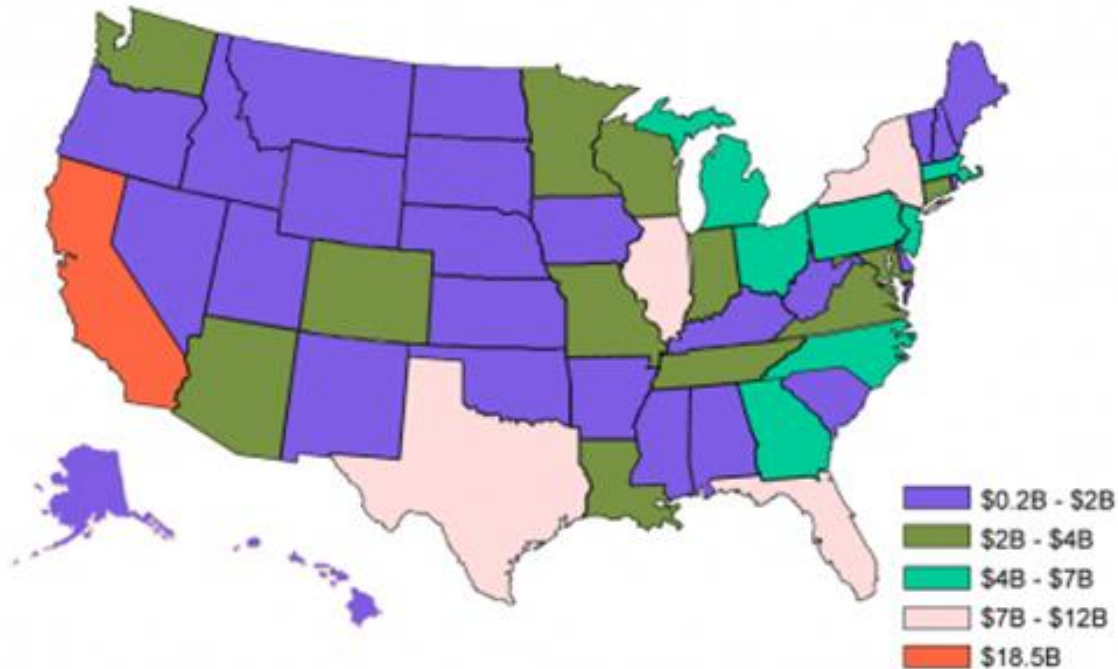




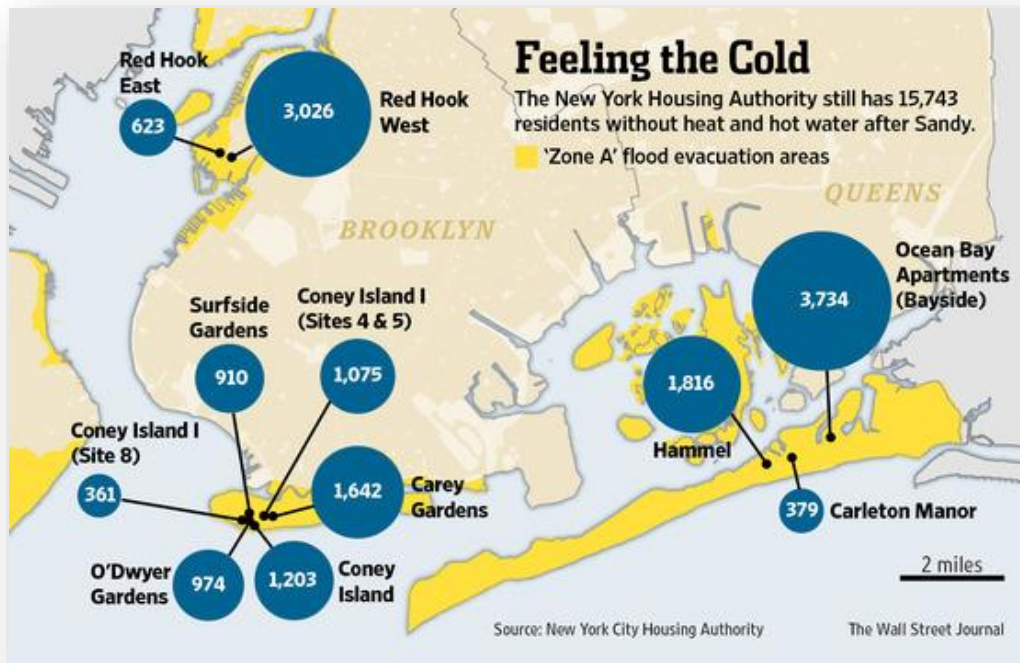
# Extreme Weather Events & Power Outages

## Annual Business Losses from Grid Problems

*Primen Study: \$150B annually for power outages and quality issues*



# Extreme Weather and Low-Income Communities

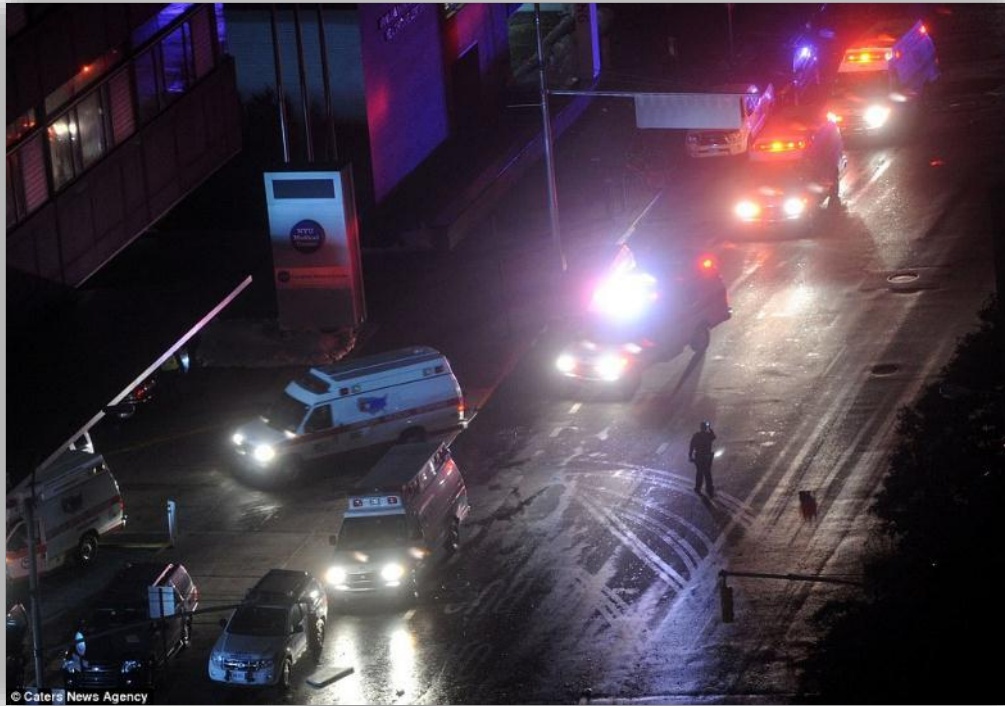


- Extreme weather causes power outages and higher electricity prices—disproportionately affecting the poor and vulnerable.
- Severe climate-related, weather events cause disproportionate harm to low-income Americans.
- Low-income & elderly populations are the most vulnerable to high or low temperatures during power outages.



- Low-income areas have more difficulty responding & recovering from destruction.
- They lack income, savings, employment, insurance, communication channels & information – less resilient after severe weather.

# Need for More Power Resilient Solutions



Hospital workers evacuate a patient from NYU Langone Medical Center during Hurricane Sandy on October 29, 2012 in New York City. More than 200 patients were evacuated from the hospital after backup generators failed due to flooding. (Michael Heiman/Getty Images)

- Critical need for reliable distributed generation (DG) & resiliency in hospitals, affordable housing, police, fire stations, schools, hospitals, community centers, gas stations
- Protect vulnerable populations
- Distributed solar with batteries, CHP, fuel cells can provide life-saving power
- DG a democratizing force through community projects
- Resilient DG is both climate mitigation and adaptation

# Resilient Power for Affordable Housing & Assisted Living Facilities

- **SuperStorm Sandy:** 375,000 New Yorkers—including 45,000 public housing residents—lived in mandatory evacuation zone.
  - Many low-income, elderly & disabled in NYC public housing were stranded.
  - No heat, backup generators, emergency boilers, or working elevators.
  - Many had no other affordable place to stay, no means of leaving their neighborhoods because mass transit did not operate.
- Small battery storage systems combined with on-site generation are needed for residents to shelter in place.
- Where possible, incorporate battery storage in HUD Better Building Partners' solar projects.



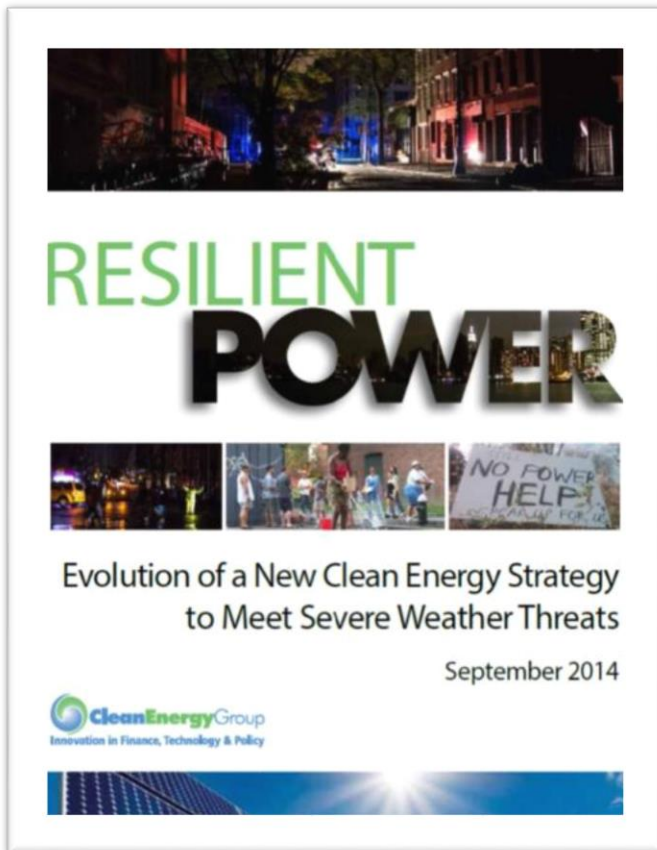
# CEG Resilient Power Project – Objectives

- Expand clean resilient power at state and municipal level
- Protect low-income and vulnerable communities
- Focus on affordable housing
- Promote new technologies/business models



- New policy and financing options
- Support local projects
- Public education, technical assistance, information sharing
- Create national network
- Support new federal initiatives

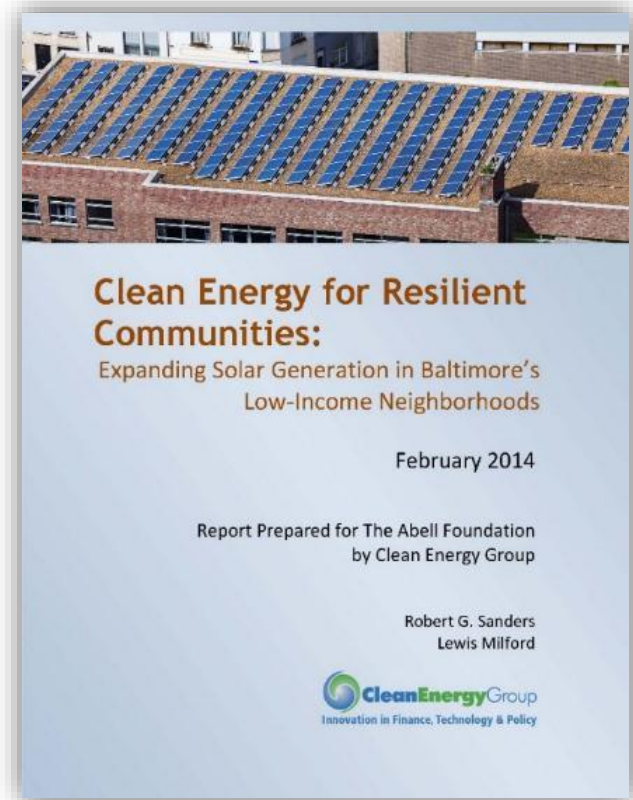
# CEG Resilient Power Project



- Goal: significantly increase public/ private investment for clean, resilient power systems.
- Engage city officials to develop resilient power policies/ programs, link to state energy policies.
- Technical assistance for resilient power projects to help agencies/ project developers get deals done.
- <http://www.cleangroup.org/assets/Uploads/Resilient-Power-Project-Evolution-Report.pdf>

# Community Resilient Power: Baltimore

- How can cities deploy more solar in low income communities and be more power resilient?
- CEG report built on Baltimore's DP3 Report that evaluated critical facilities/ infrastructure.
  - Focus on community buildings
  - Bonds and credit enhancement mechanisms
  - Public buildings and nonprofit-owned facilities.
  - Third-party ownership, lease-financed
  - Foundation PRIs
  - Public schools, libraries, police/fire stations.
  - Explore legal exposure under ADA.
  - The full report can be downloaded at <http://bit.ly/RPP-ResilientCommunities>.



# Innovative Financing Models

- Once decision is made to pursue resilient power project – how do you finance it?
- Municipalities, housing/ community developers have broad range of options.

## BOND FINANCING

General obligation bonds  
Morris Model  
501(c)(3) bonds  
Housing bonds  
School construction bonds  
Disaster recovery/climate resiliency bonds  
Commercial/municipal PACE bonds

## PUBLIC AND PRIVATE OWNERSHIP STRUCTURES

3rd party ownership with PPA  
Municipal improvement districts  
Utility ownership

## CLEAN ENERGY FINANCIAL INSTITUTIONS

State Energy Resilience Banks  
Warehouse credit facility  
West Coast Infrastructure Exchange model

## CREDIT ENHANCEMENTS

Public benefit funds  
U.S. DOE Loan Guaranty

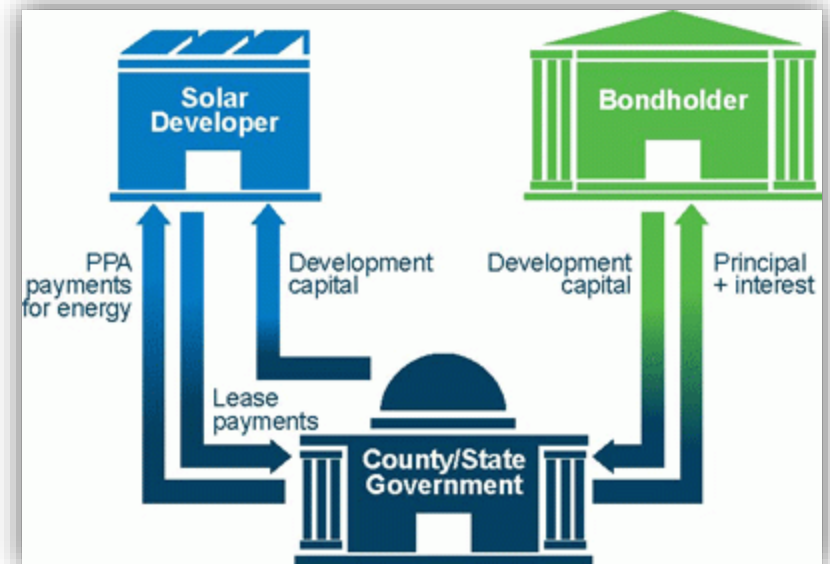


Source: Clean Energy Group



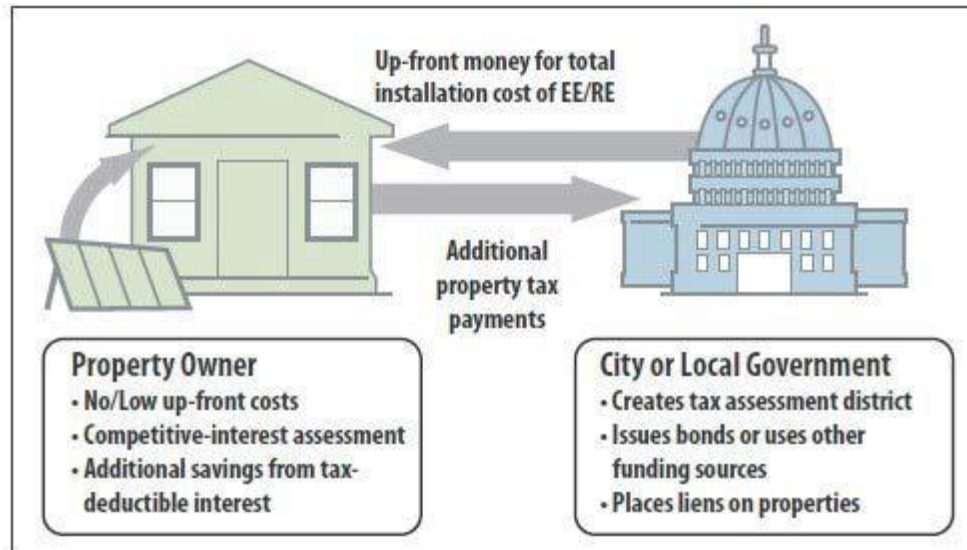
# Bond Financing

- Existing bond tools can be used to finance pooled resilient power projects
  - GO bonds: NYC City Controller – multi-billion dollar “Green Bond Program”
  - 501(c)(3) bonds: hospitals, universities, affordable housing, community facilities
  - School construction bonds
  - Disaster recovery/ resiliency bonds: NYC Green Bond Program, Louisiana PSC (\$315M of bonds by a LA bond authority for disaster recovery & reserves for future storms)
- Morris Model:
  - Innovative public-private financing for solar on public buildings
  - Hybrid model: public entity issues a government bond, transfers low cost capital to developer for lower PPA price.
  - Bonds are issued for a pool of projects



# Bond Financing

- C-PACE bonds:
  - Provides states & municipalities with financing for CE building projects
  - Bonds are repaid by property assessments added to building owners' property taxes.



# Clean Energy Finance Institutions

## **NJ Energy Resilience Bank:**

- First-in-the-nation Energy Resilience Bank (ERB).
- Designed to address a repeat of the devastating impacts of SuperStorm Sandy:
- \$200 million of CDBG-DR funds for municipalities to finance clean resilient power solutions.
- For critical public facilities, initially clean water/ wastewater treatment facilities
- Other critical facilities: public housing, schools used as emergency shelters, hospitals, emergency response facilities, etc.
  
- Jointly managed by NJ BPU and NJ EDA
- Direct loans and grants, but can also provide credit enhancement for bond issuances, etc. A model other states should evaluate for possible replication.

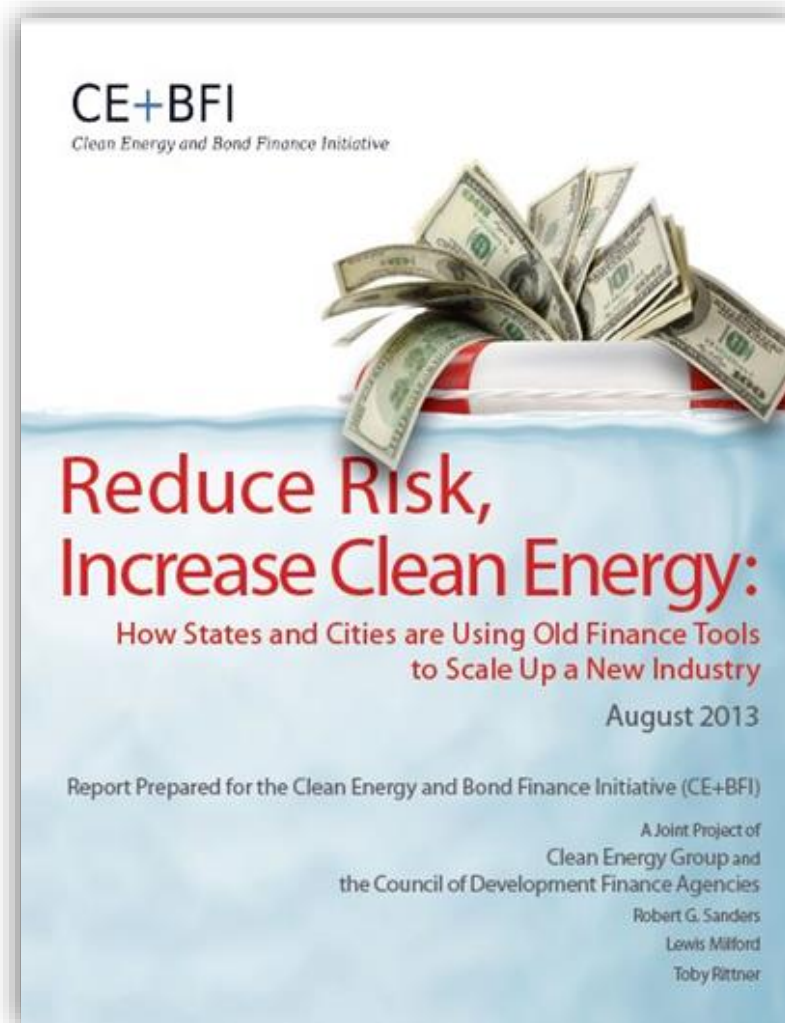


# Credit Enhancement

- Risk reduction methods that improve credit worthiness of a projects/ companies, reduce cost of borrowing.
  - Guarantees, pledge of additional collateral, cash reserve accounts, subordinated debt
- SBC funds used as credit enhancement
  - Hawaii Green Infrastructure Loan Program
- U.S. DOE Loan Guaranty Program
  - \$4 billion in loan guarantees to support innovative CE/EE projects
  - 5 eligible technology areas, the first of these grid integration & storage (microgrid, resilient power)
  - Opportunity to aggregate projects statewide and regionally.

# Credit Enhancement

- New framework for CE investment being built by states providing credit enhancement
- “Reduce Risk, Increase Clean Energy”
  - States are playing an important transitional role to a time when CE securities are a readily traded asset class
  - By reducing risk for investors, states are also reducing the cost of financing and securing long term fixed rate capital for CE
  - <http://www.cleangroup.org/assets/Uploads/2013-Files/Reports/CEBFI-Reduce-Risk-Increase-Clean-Energy-Report-August2013.pdf>



# Public & Private Ownership Structures

- Over the past decade, companies such as SolarCity transformed residential solar PV by providing lease financing.
- Third-party ownership is largely responsible for tremendous growth in residential solar in recent years.

– **Can lease financing (3<sup>rd</sup> party ownership) accomplish for energy storage what it did for residential solar PV?**



# Third-Party Ownership

- Solar Grid Storage & other storage developers are proving the model out for commercial, government & nonprofit entities.
  - Eliminates upfront costs to host
  - Transfers development & performance risk to the private developer.
- These companies' business models have benefited greatly from new FERC rules:
  - Owners of solar + storage systems can receive additional revenue streams from providing ancillary grid services:
    - E.g., demand response, frequency regulation services
    - ISOs need to pay sellers for frequency regulation-related performance payments for faster, more accurate response to dispatch signals
  - These new business models can make it much easier for customers to include storage using third party leasing and PPA financing.

# Utility-owned & financed microgrids with resilient power



- **Vermont Solar + Storage Resilient Power Microgrid**
- One of the first US exclusively solar-powered microgrids
- First to provide full back-up power to an emergency shelter on the distribution network, first solar+storage microgrid developed on a landfill/brownfield site.
- Project supported with funding from federal-state-NGO partnership – remaining financing was rate-based.

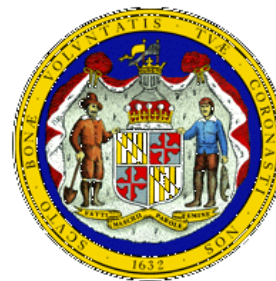


- Incorporates 7,722 solar panels, capable of generating 2.5 MW of electricity
- Incorporates 4 MW of battery storage, both lithium ion and lead acid, to integrate the solar generation into the local grid
- Will provide resilient power to a Rutland school that serves as an emergency shelter (additional critical facilities may be similarly supported by this microgrid in the future)



# Results

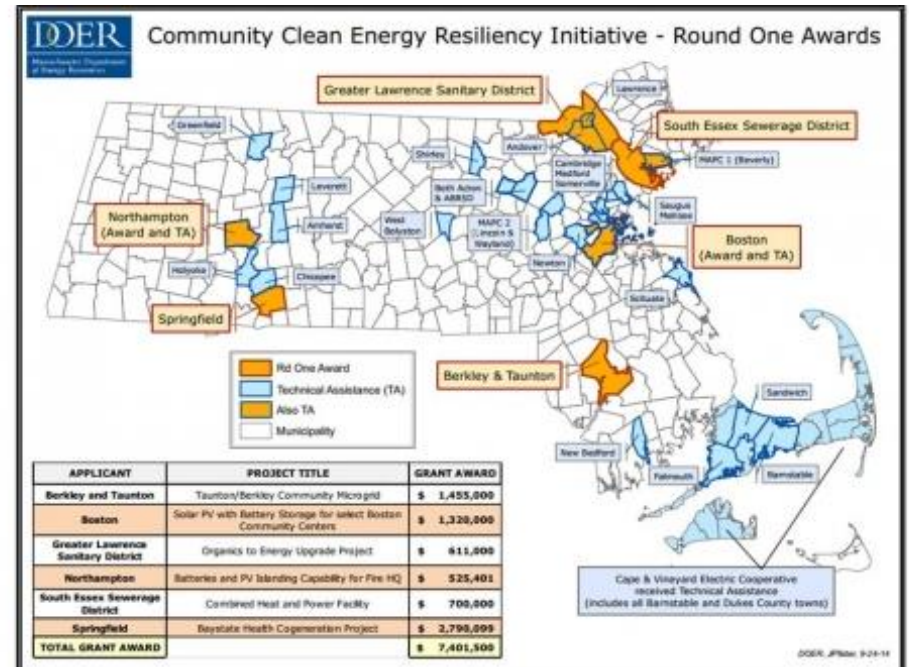
- **Connecticut** Department of Energy and Environmental Protection (DEEP): \$48 Million Microgrid Grant and Loan Pilot Program
- **New Jersey** Board of Public Utilities (BPU): \$200 Million Energy Resilience Bank and \$10 Million Energy Storage Program
- **Massachusetts** Department of Energy Resources (DOER): \$40 Million Community Clean Energy Resiliency Initiative
- **New York** State Energy Research and Development Authority (NYSERDA): \$40 Million NY Prize microgrids competition and \$66 million CHP program
- **Maryland** Energy Administration Microgrids RFP: Coming This Fall



**TOTAL: >\$400 Million in new state funds in the Northeast alone**

# Massachusetts DOER Community Clean Energy Resiliency Initiative

- \$40 million state incentive
- \$ coming from ACP payments
- Focus on critical infrastructure
- Municipal-led projects
- Technology agnostic
- Includes Technical Assistance Fund



See <http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/resiliency-initiative.html>

\* MassCEC pursuing additional resilient power projects

# Massachusetts DOER Community Clean Energy Resiliency Initiative

## Round 1 Results

| Applicant                          | Project Title   | Grant Amount        | Brief Description  | Facility(ies)  |
|------------------------------------|---|---------------------|--|--|
| Berkley and Taunton                | Taunton/Berkley Community Microgrid                               | \$ 1,455,000        | Community microgrid  | (1) Middle School - shelter<br>(2) Emergency Services Building - Police and Fire<br>(3) Community School - shelter<br>(4) Municipal fueling station/pump<br>(5) Police/fire radio repeater |
| Boston                             | Solar PV with Battery Storage for select Boston Community Centers | \$ 1,320,000        | Solar and storage based islandable community shelters  | (1) Shelburne Community Center - shelter<br>(2) Roslindale Community Center - shelter<br>(3) Tobin Community Center - shelter<br>(4) Curtis Hall Community Center - shelter                |
| Greater Lawrence Sanitary District | Organics to Energy Upgrade Project                                | \$ 611,000          | Islandable and black start capable self-sustaining wastewater treatment facility                                     | (1) Wastewater treatment facility  |
| Northampton                        | Batteries and PV Islanding Capability for Fire HQ                 | \$ 525,401          | Solar and storage based islandable fire station, that incorporates existing backup generation for further resiliency | (1) Northampton Fire Department  |
| South Essex Sewerage District      | Combined Heat and Power Facility                                  | \$ 700,000          | Islandable and black start capable combined heat and power facility at wastewater treatment facility                 | (1) Wastewater treatment facility  |
| Springfield                        | Baystate Health Cogeneration Project                              | \$ 2,790,099        | Islandable and black start capable combined heat and power facility at regional hospital                             | (1) Baystate Health - hospital   |
| <b>Total</b>                       |   | <b>\$ 7,401,500</b> |  |  |

# Conclusion

- Financing is just one key public resource that is needed to accelerate the deployment of resilient power for critical facilities and infrastructure.
  - Technical assistance
  - Targeted support for pre-development costs
  - Consistent, supportive policy

# RESILIENT POWER PROJECT DEVELOPMENT



Henry Misas  
Sr. Project Engineer  
Bright Power, Inc.



# RESILIENT POWER SOLUTIONS

- **Backup Power Sources**

- Backup Generator
- Co-Generation (CHP)
- Solar PV
- Energy Storage (Batteries)
- Fuel Cell



Combined Heat and Power



Energy Storage



Solar PV



Backup Generator



# INTEGRATION AND CONTROLS

- Controls must manage various levels of operation and reliability
- Grid-tied vs Island Modes
- Project Developer must integrate distributed energy resources



Benecia City Hall – Geli EOS Web Dashboard

# NEED FOR POWER RESILIENCY

- **Facility types**

- Public (schools, police and fire stations)
- Community Center / Shelter
- Healthcare
- Multifamily

- **Critical Loads**

- Elevators
- Water Pumps
- Lighting
- Heating System
- Telecom devices



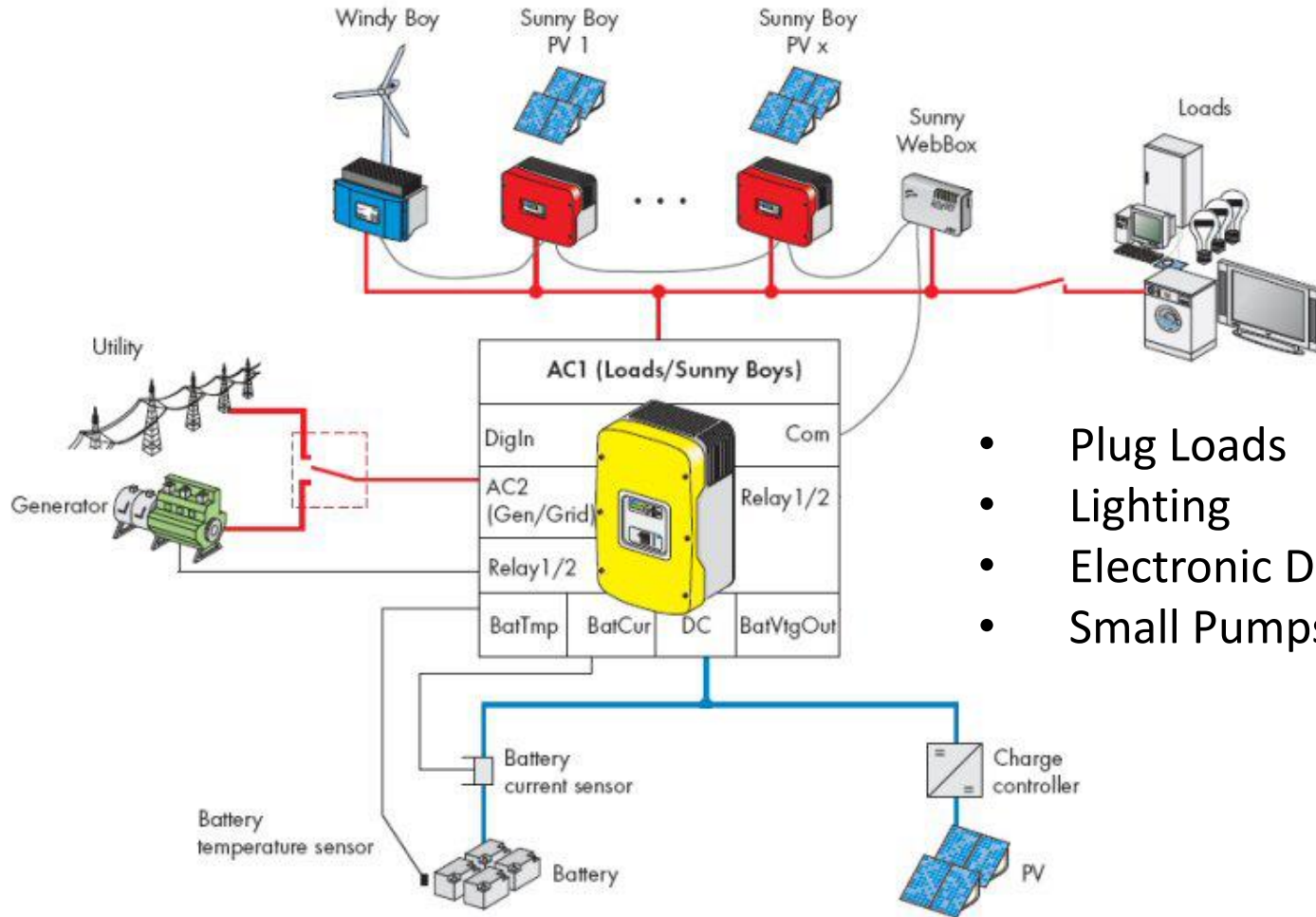
Water Booster Pumps

Grid Connection





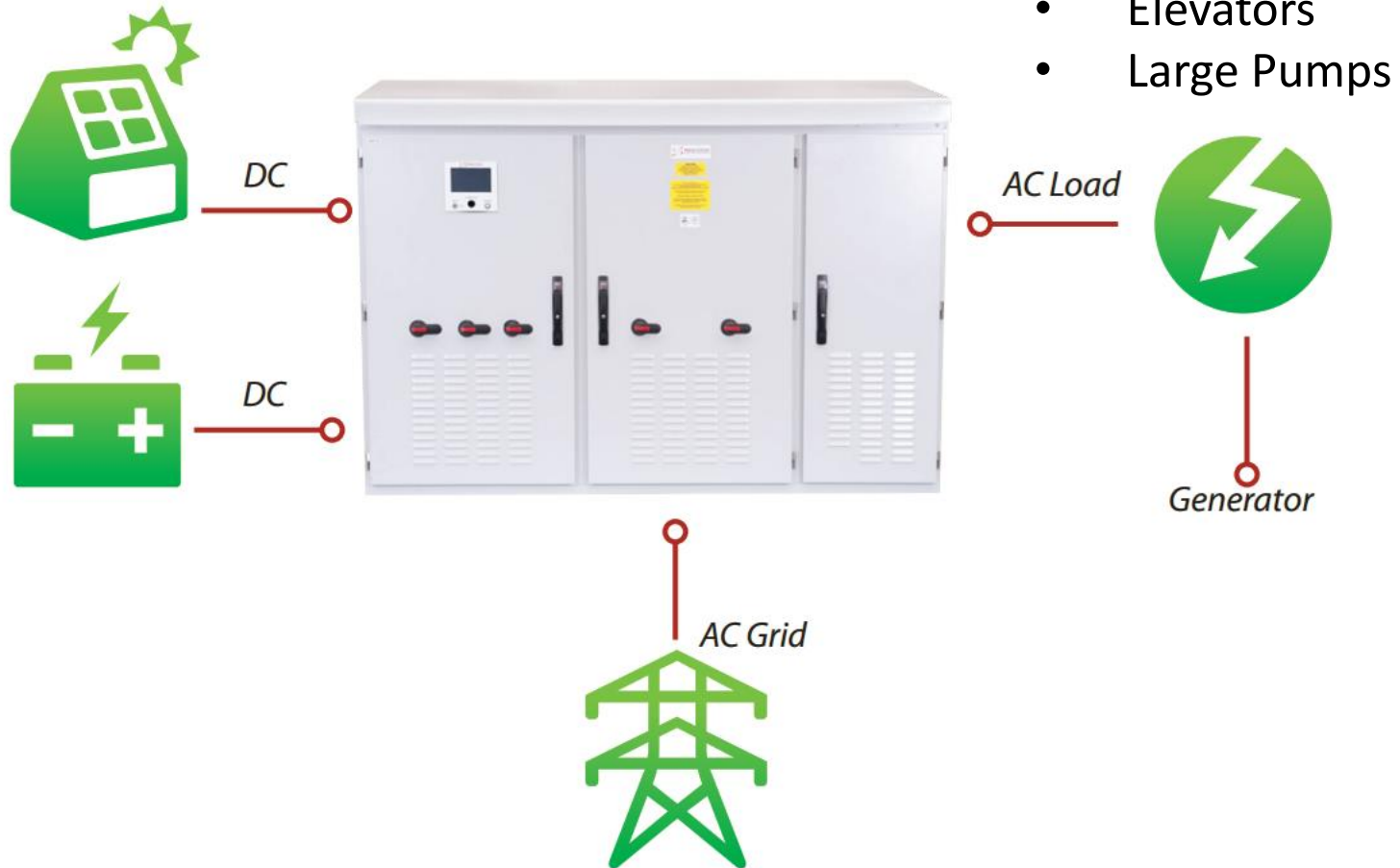
# BACK-UP POWER FOR SMALL LOADS



- Plug Loads
- Lighting
- Electronic Devices
- Small Pumps

*Schematic from SMA*

# BACK-UP POWER FOR LARGE LOADS



*Schematic from Princeton Power Systems*

# PROJECT PROFILE

- **Resiliency Pays for Itself**

- On-site electricity and heat generation
- Demand management (reducing kW charges)
- Grid support

- **Incentive Programs**

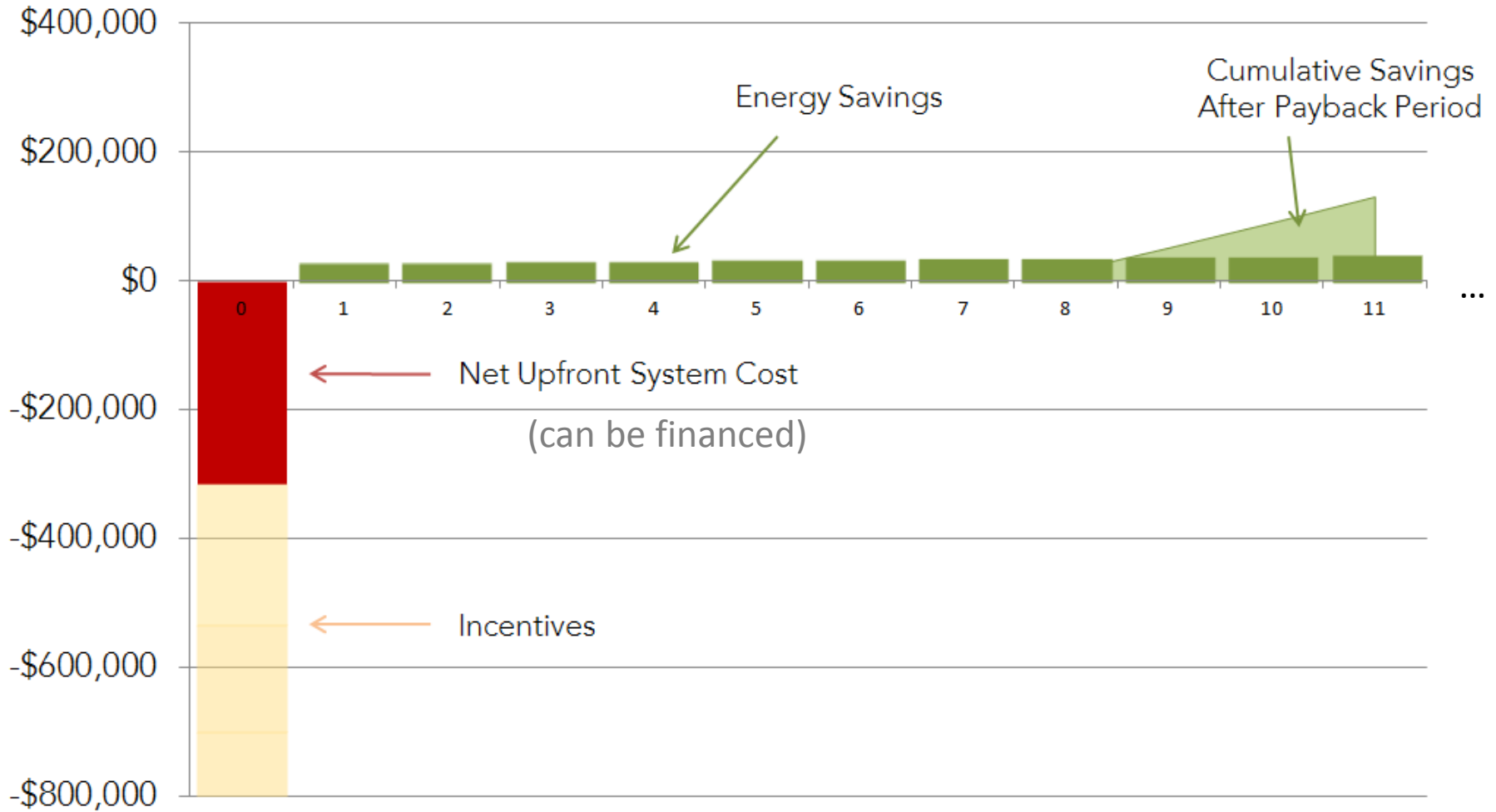
- Tax Credits
- State (New York - NYSERDA)
  - Co-Gen Performance Based Incentive
  - Demand Management Program
  - Solar PV Rebate
- Local (New York City)
  - Con Edison - Demand Response Program
  - NYC Property Tax Abatement

- **Financing Options**

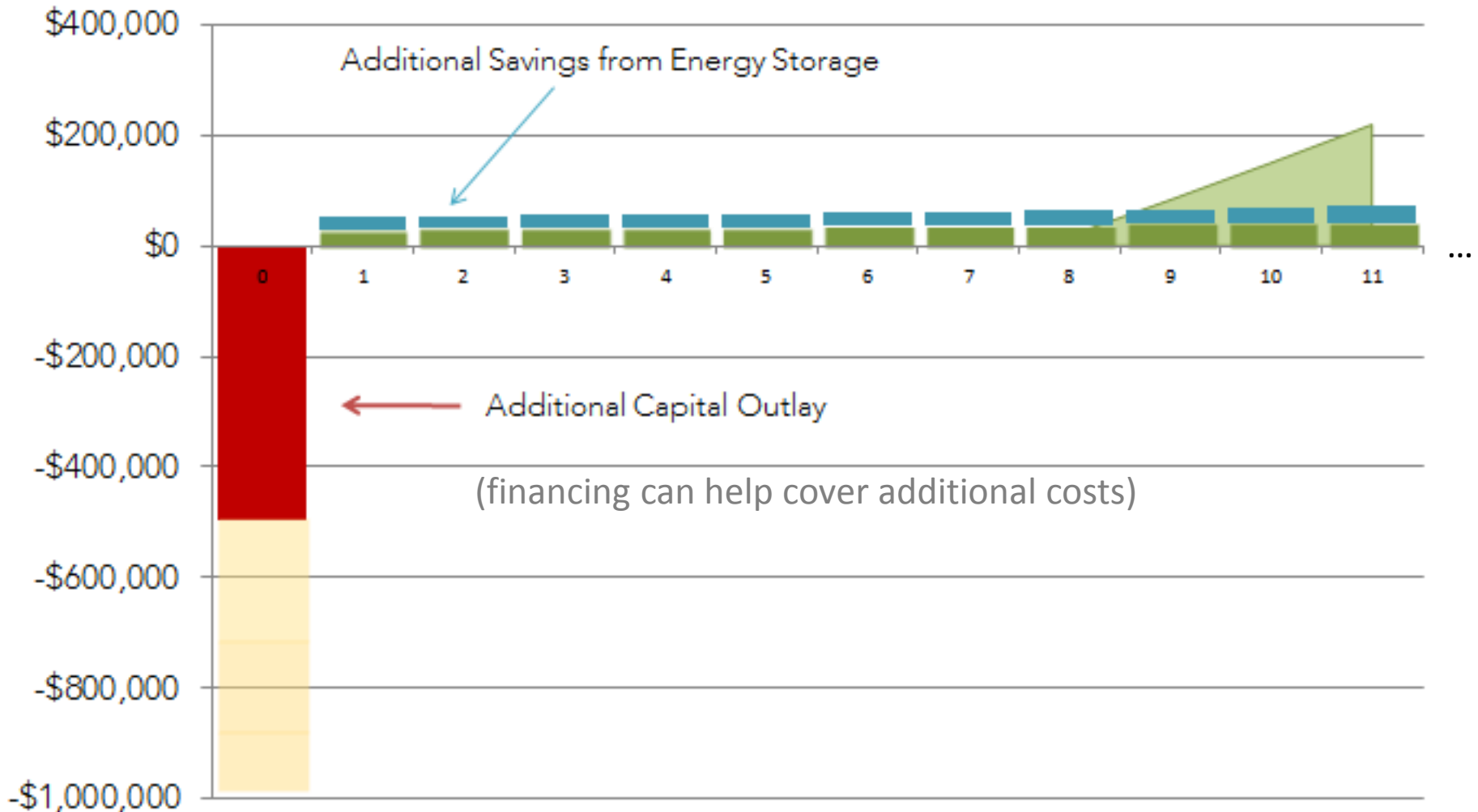
- Outright Purchase
  - Cash
  - Private or Public Loans
- Capital and Operating Lease
- Third Party Ownership



# SOLAR PV PROJECT - CASH FLOW

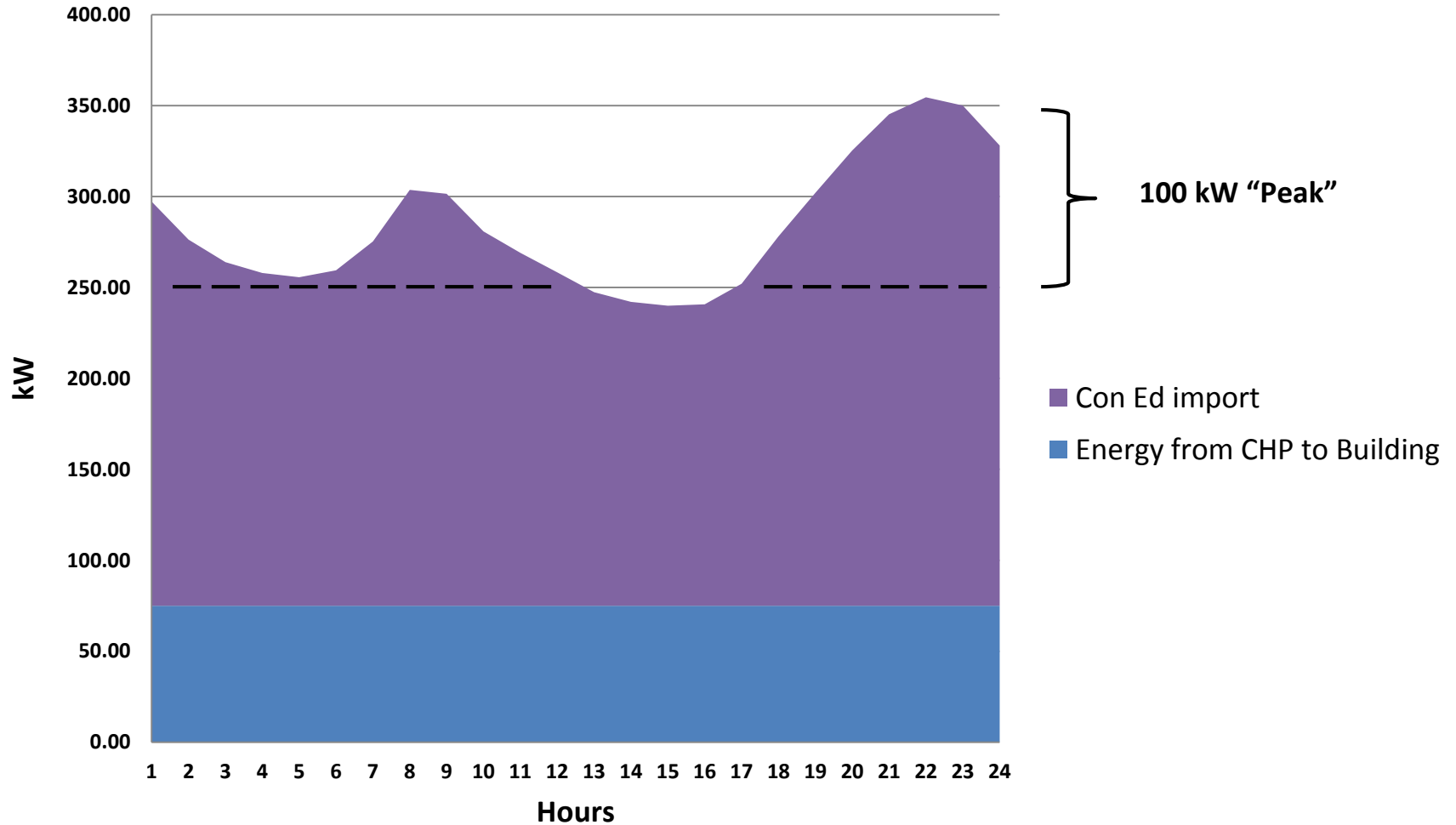


# SOLAR PV + STORAGE PROJECT - CASH FLOW



# DEMAND CHARGE REDUCTION

## Typical Multifamily Building - Daily Load Profile



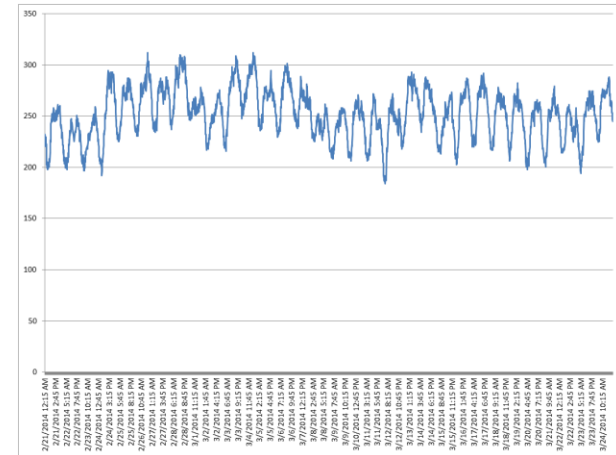
# PROJECT SCOPING PROCESS

- **Project budget**
  - Obtain turn-key installation and O&M costs
- **Savings**
  - Energy offset (electricity and/or heat)
  - Demand charge reduction
  - Enrollment in utility / system operator grid support programs
- **Incentives**
  - Need to obtain incentive award letter that guarantees availability and amount.
- **Value of resiliency & insurance**
  - Has the facility been impacted by grid / weather disruptions in the past?
  - Can the resiliency benefits enhance the project economics?

# FEASIBILITY STUDY

- **Analysis**

- Utility Bills / Interval Data
- Simulation / Modeling
- System Sizing
- Building Plan Review
- Site Visit



- **Technology / Vendors**

- Approved products by Authorities Having Jurisdiction

- **Project Specification for Pricing**

- Drawing set
- Book specifications

- **Contractor and Maintenance Provider**



# SAMPLE BATTERY RETROFIT PROJECT



- Via Verde (Bronx, NY)
- 66 kW Solar PV Array, built in 2012
  - No energy storage
  - Emergency Generator on site



- CODA Core™ Tower (left),
- Princeton Power 30 kW Inverter (middle),
- Cummins Automatic Transfer Switch (right)

**THANK YOU!**

**Connect with Henry:**

Henry Misas

Sr. Project Engineer

Bright Power, Inc.

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# Resilient Power Project Upcoming Events & Links

- CEG Webinar: MassDOER Resilient Power Solicitation Results, Wednesday, December 3, 1-2pm ET <http://bit.ly/CEG-MassDOER-Webinar>
- CESA Webinar: Accelerating Resilient Power in CT and NY, Tuesday, December 16, 1-2pm ET <http://bit.ly/CT-NY-Webinar>
- RPP e-Distribution List Sign-Up to get notices of future webinars and the *Resilient Power Project Newsletter*: <http://bit.ly/RPPNews-Sign-Up>
- More information about the project, its reports, and other information can be found at [www.resilient-power.org](http://www.resilient-power.org).

# Contact Info

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