

# RESILIENT



# POWER

A Project of **Clean Energy Group**

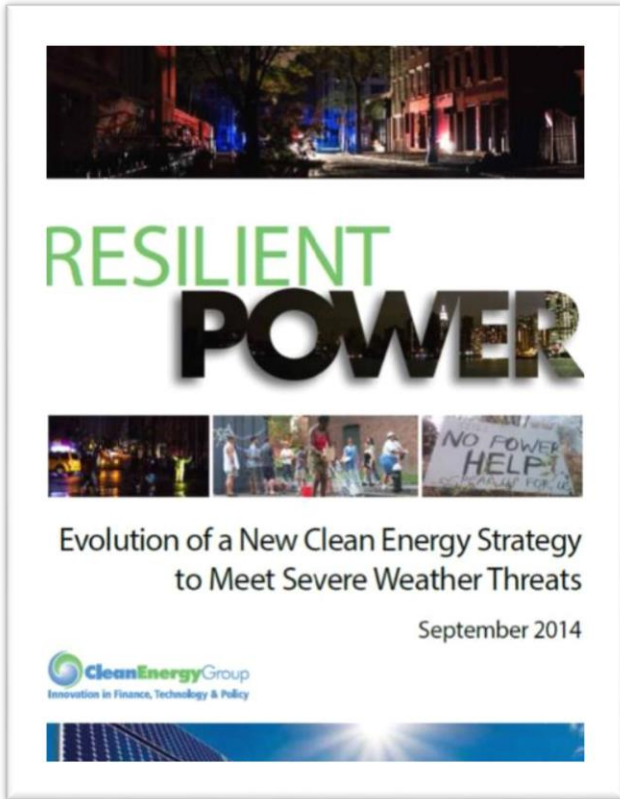
## **Clean Energy Group Webinar: An Introduction to Resilient Power**

**October 8, 2014**

**Lew Milford, Todd Olinsky-Paul, Rob Sanders**



# Who We Are



[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.

Universities' emergency generators weren't adequate. First National Bank isn't the only company that has turned to fuel-cell technology. In fact, it's the only company that offers a critical city service that can't be replaced by other means. It's the only company that offers a critical city service that can't be replaced by other means. It's the only company that offers a critical city service that can't be replaced by other means.

Time to! our ou' power



CleanEnergyGroup  
Innovation in Finance, Technology & Policy

WHO WE ARE | CEG PROJECTS | CEG RESOURCES

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

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

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- Getting Gas Right: A New Strategy for a Net-Carbon Future
- Northeast Wind Resource Center (NWRC)

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



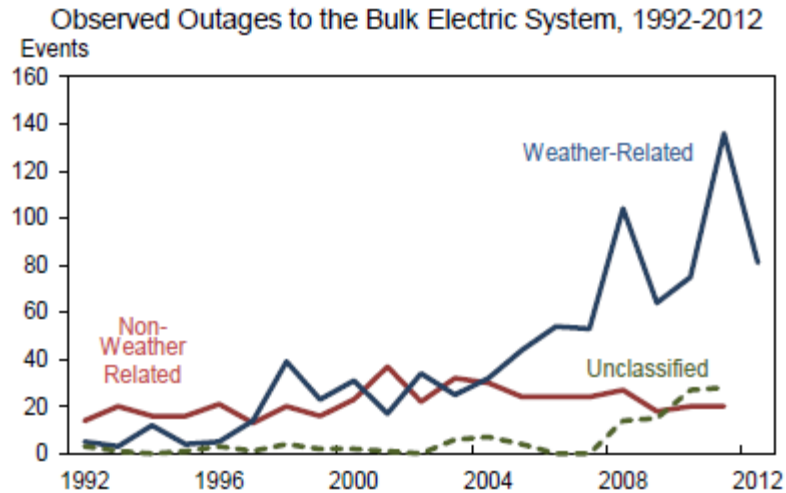
Prepared by Clean Energy Group

OCTOBER 2005

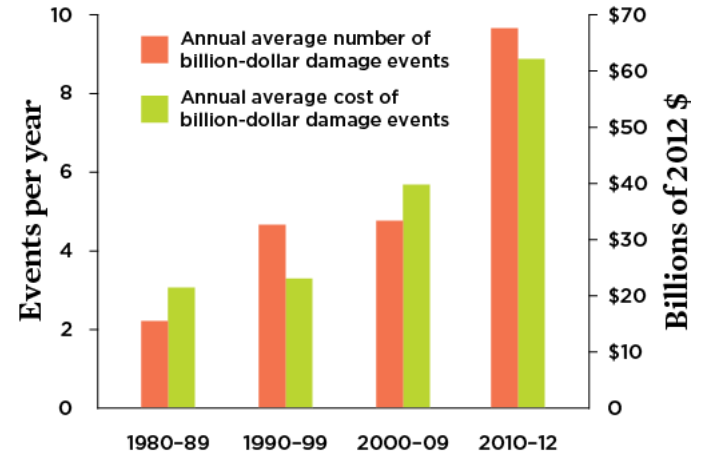
# RESILIENT POWER

A Project of Clean Energy Group

# Aging US Power Grid Blacks Out More Than Any Other Developed Nation\*



Source: Energy Information Administration



Source: Union of Concerned Scientists; Steve Clemmer, 2014

Year	Total number of outages	People affected
2008*	2,169	25.8 million
2009	2,840	13.5 million
2010	3,149	17.5 million
2011	3,071	41.8 million
2012	2,808	25.0 million
2013	3,236	14.0 million

\*Partial-year data. Data collection began on February 16, 2008.

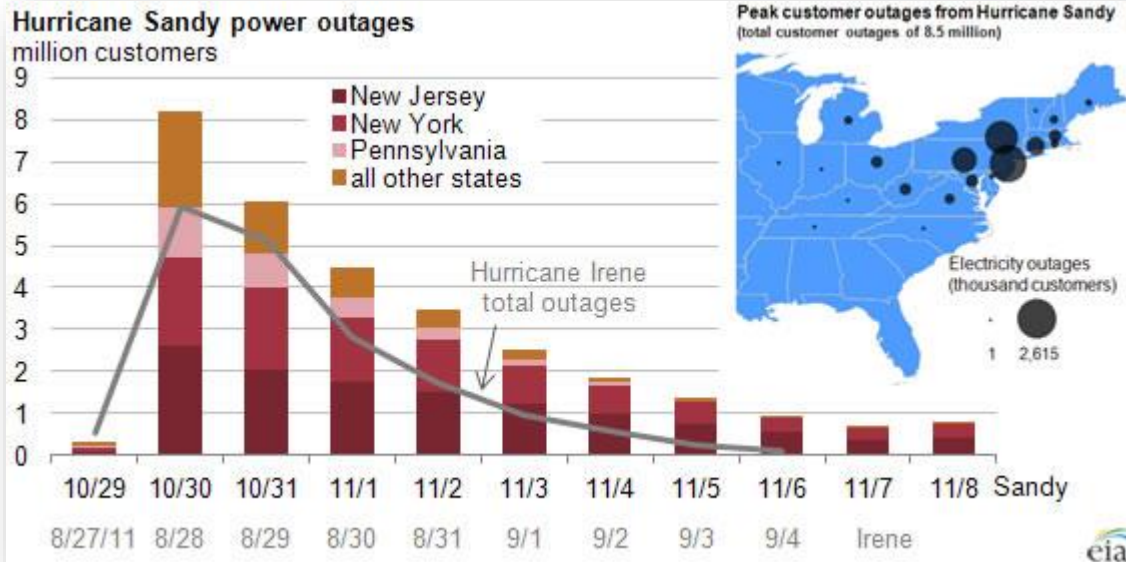
Source: Blackout Tracker – 2013 US Report (Eaton)

\* See: <http://www.ibtimes.com/aging-us-power-grid-blacks-out-more-any-other-developed-nation-1631086>

# 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.”

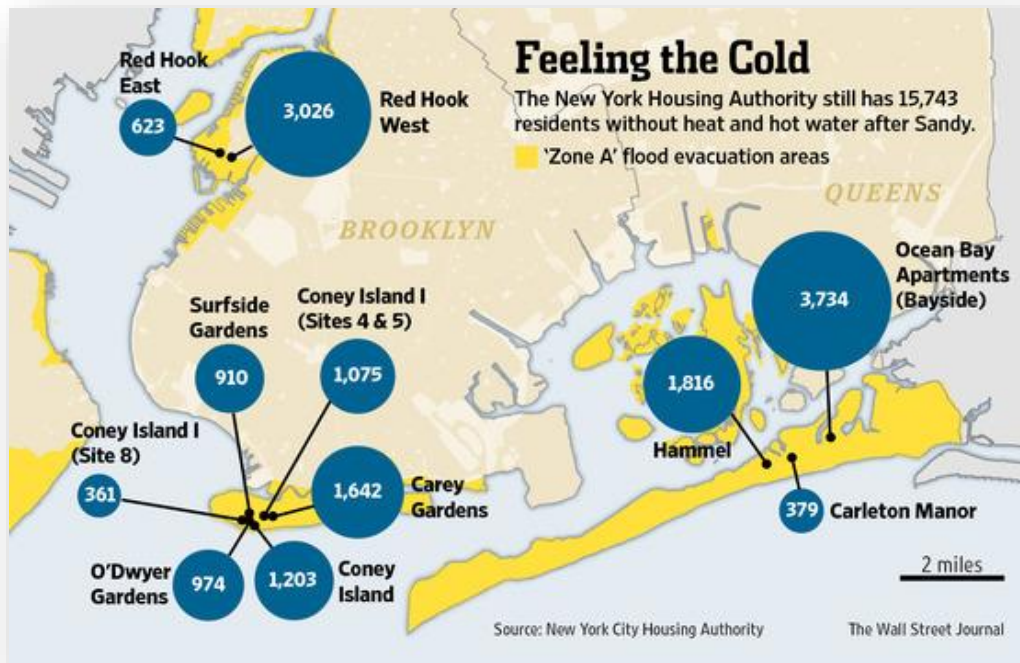
*Hurricane Sandy Rebuilding Strategy:  
Stronger Communities, A Resilient Region (Aug. 2013)*



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



# Extreme Weather 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.

# Extreme Weather Disproportionately Hurts Vulnerable & Low-Income Communities

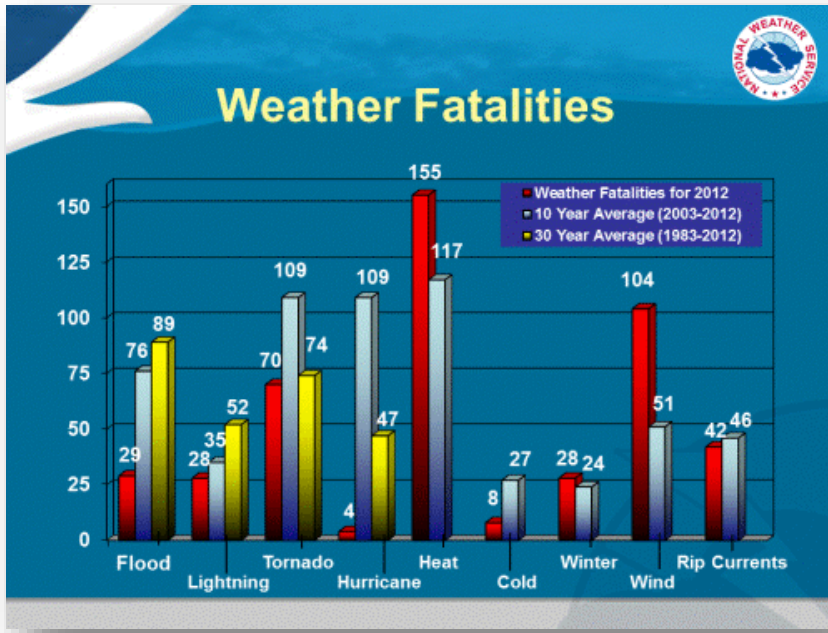


- Extreme weather events harm more counties with lower income households.
- Flooded counties had households at 14% below US median income.
- Drought & heat waves affected counties with households at 5% below US median income.



- **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.

# Heat and Climate Stress People and Power



“Changes in climate have the potential to significantly impact U.S. energy security by forcing the present aging energy system to operate outside of the ranges for which it was designed.”

**U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather**, U.S. Department of Energy, July 2013.  
<http://energy.gov/sites/prod/files/2013/07/f2/20130710-Energy-Sector-Vulnerabilities-Report.pdf>

- In summer of 2012, prolonged 14-day extreme heat event in MD, OH, VA, and WV knocked out power for 3.8 million people for 8 days.
- 32 people died from excessive heat exposure worsened by power loss.
- Urban heat island and health effects-  
<http://www.sciencedirect.com/science/article/pii/S1353829214001087>
- All infrastructure systems are vulnerable to power outages: buildings, utilities, gasoline, health care, telecommunications, emergency management, transportation, water.

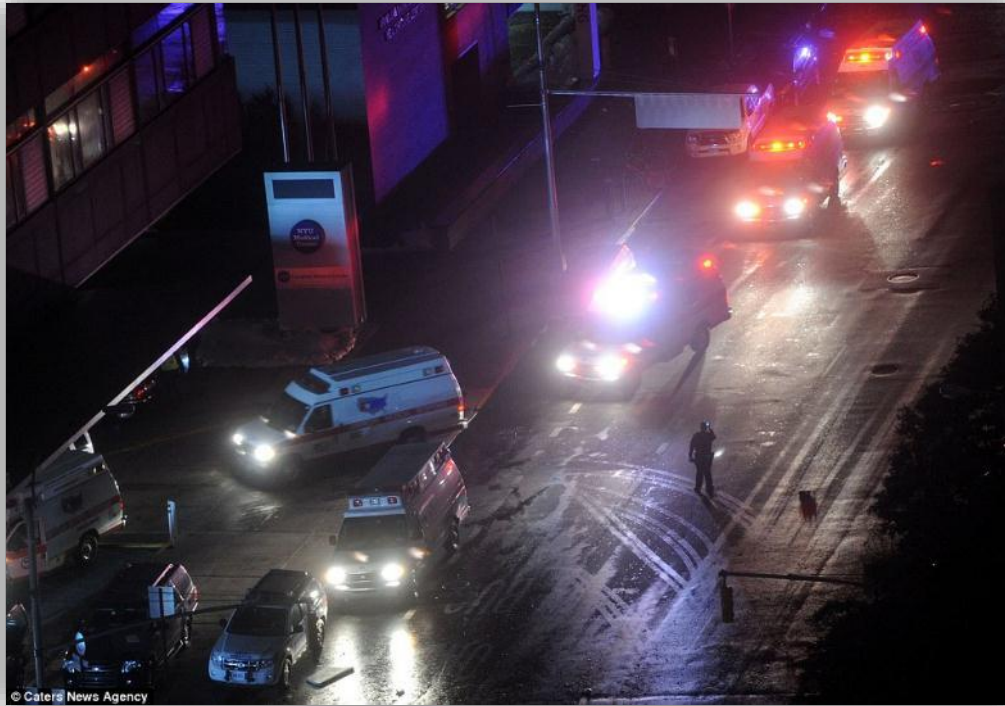


# Hurricane Sandy's Toll on Small Businesses

- 74% of small business owners had to close their doors after Hurricane Sandy.
- 71% of small businesses owners say they lost power as a result of the storm,
- 56% lost phone and internet connectivity.
- 11% of small businesses experienced structural or property damage.
- Small business employees unable to get to work
- Suppliers unable to reach businesses with deliveries.



# 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

# CEG Resilient Power Project – Objectives

- Expand clean RPP 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 – Stakeholders

- States
- Municipalities
- State-Federal agency collaboration
- Low-Income and vulnerable communities

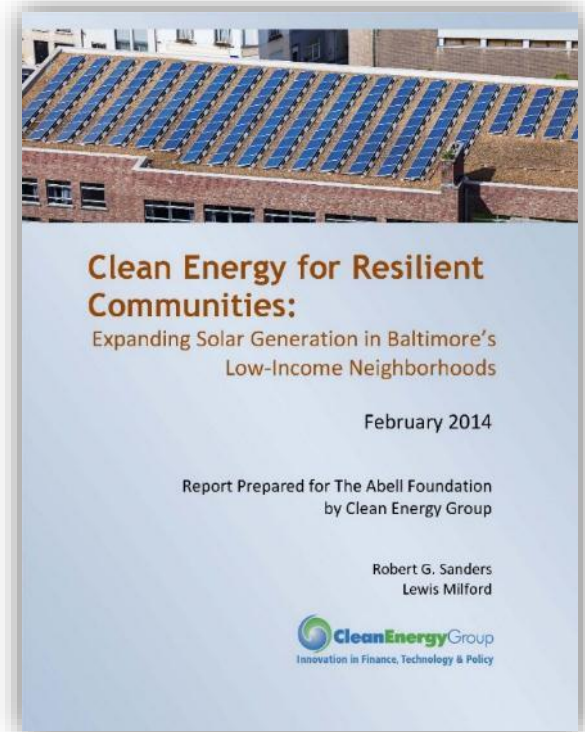


- Critical facilities managers
- Public housing developers
- Project developers

# Community Resilient Power: Baltimore

For community resilient power in Baltimore's low income communities, evaluate critical facilities for solar battery storage.

- Focus on community buildings
- Bonds and credit enhancement mechanisms
- Public buildings and nonprofit-owned facilities.
- Third-party or 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>.



# New York City Green Bonds

- Bonds for city resiliency
- \$25 billion scale
- Largest domestic green bond commitment in US
- Emerging model
- Need to adopt widely



[http://comptroller.nyc.gov/wp-content/uploads/documents/Green\\_Bond\\_Program\\_September.pdf](http://comptroller.nyc.gov/wp-content/uploads/documents/Green_Bond_Program_September.pdf)

# 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.



# New Business Models Needed for Appropriate Size Technology

- Develop an appropriately sized resilient power business model for affordable and elderly housing, assisted living.
- Small battery storage systems combined with on-site generation.
- For critical loads: lighting, air conditioning/ refrigeration and medical/ communications.
  - Enables residents to shelter in place.
  - Reduces demands on overwhelmed first responder & emergency shelter services.
- Will better protect low income, elderly and disabled populations.





# Power Resiliency And City Planning: A New Energy Assurance Planning for Climate

- City officials aware of need for power resiliency planning.
- Map critical facilities / loads for new distributed generation.
- Institutionalize roles for energy resiliency planning.
- Train city officials about resilient power issues.
- Need for national and local thought leadership.
- Emerging CA “Energy Assurance” Model: CaLEAP is designed to assist local governments develop plans to become more energy resilient; ensuring energy supply to “key assets.” <http://www.caleap.org/>

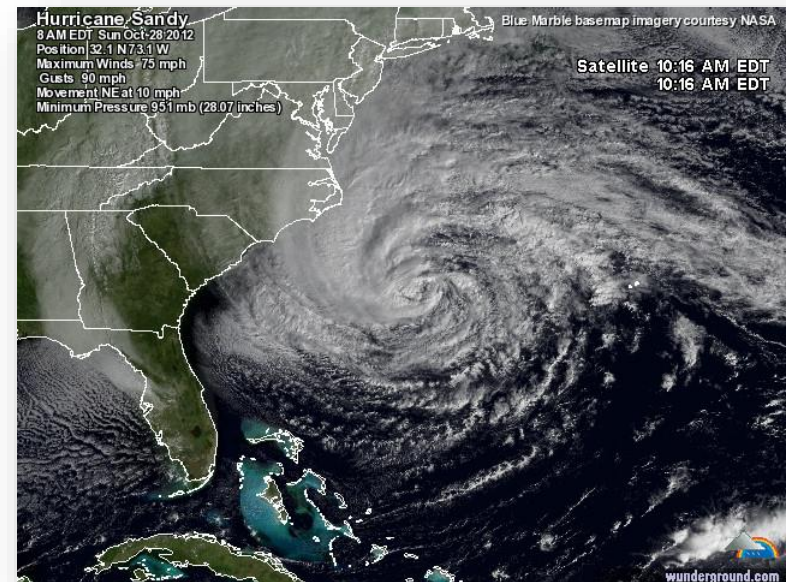


# Northeastern States Resilient Power Initiatives

Following Hurricane Sandy, the Northeastern states began to work with Clean Energy Group to develop resilient power solutions.

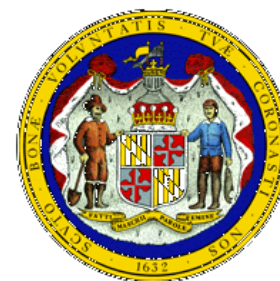
CEG's role:

- Assist with program development
- Assist with RFP development
- Facilitate information sharing
- Provide technical assistance
- Provide information to stakeholders



# 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**

# Connecticut Microgrid Grant and Loan Pilot Program

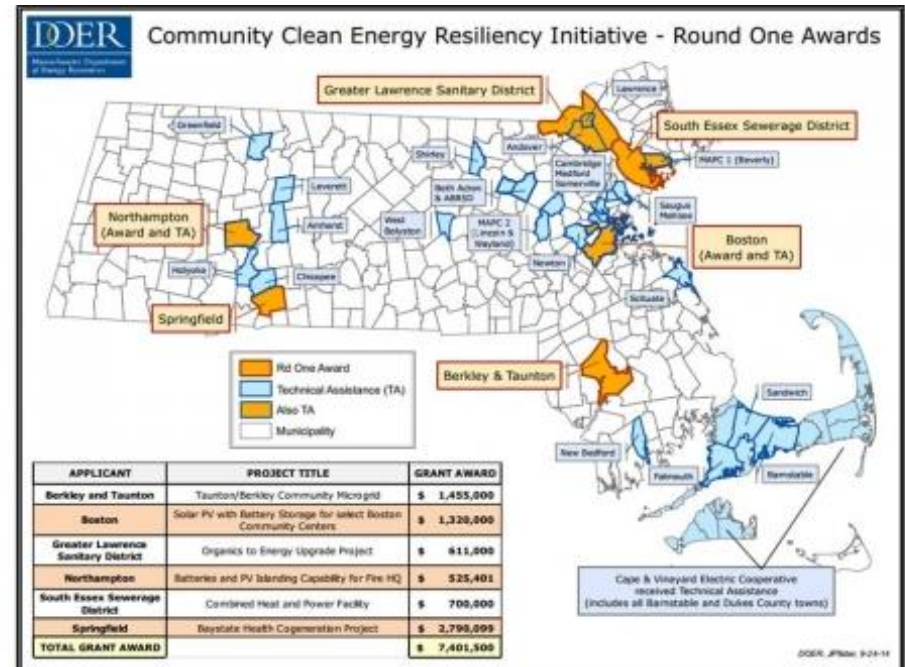
## Round 1 Results

Project	Facilities	Generation	Grant Value
UConn Depot Campus/Storrs	Campus Buildings	400 kW fuel cell, 6.6 kW PV	\$2,144,234
City of Bridgeport-City Hall/Bridgeport	City hall, Police Station, Senior Center	(3) 600 kW natural gas microturbines	\$2,975,000
Wesleyan/Middletown	Campus, Athletic Center (Public Shelter)	(1) 2.4 MW and (1) 676 kW Natural Gas Combined Heat and Power Reciprocating Engine	\$693,819
University of Hartford- St. Francis/Hartford	Dorms, Campus Center, Operation Building	(2) 1.9 MW diesel (existing), 250 kW diesel, 150 kW diesel	\$2,270,333
SUBASE/Groton	Various Buildings and Piers	5 MW cogen turbine, 1.5 MW diesel	\$3,000,000
Town of Windham/Windham	2 Schools (Various Public Purposes)	(2) 130 kW natural gas, 250 kW solar, 200 kWh battery; (2) kW diesel,	\$639,950
Town of Woodbridge/Woodbrid ge	Police Stations, Fire Station, Department of Public Works, Town Hall, High School, Library	1.6 MW natural gas, 400 kW fuel cell	\$3,000,000
City of Hartford- Parkville Cluster/Hartford	School, Senior Center, Library, Supermarket, Gas station	600 kW natural gas	\$2,063,000
Town of Fairfield- Public Safety/Fairfield	Police Station, Emergency Operations Center, Cell Tower, Fire Headquarters, Shelter	50 kw natural gas recip engine, 250 kW natural gas recip engine, 27 kW PV, 20 kW PV	\$1,167,659

*\* Round 2 now underway*

# 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 (2) Emergency Services Building - Police and Fire (3) Community School - shelter (4) Municipal fueling station/pump (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 (2) Roslindale Community Center - shelter (3) Tobin Community Center - shelter (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>		

# New Jersey Energy Resilience Bank (ERB)

- July 2014: Nation's 1st Energy Resilience Bank
- Finance local distributed resilient power projects
- Funded with \$200 million in NJ CDBG-Disaster Recovery allocation
- Loans & grants, but can also provide credit enhancement for bond issuances & other financing.
  - Initial priority wastewater treatment
  - Others to come: public housing, hospitals, emergency response facilities, municipal buildings, correctional facilities, transportation & transit, school emergency shelters.



Next webinar: **New Jersey's Energy Resilience Bank** – October 28th at 2 pm; sign up at <http://bit.ly/RPP-NJERB>

# Vermont Solar + Storage Resilient Power Microgrid



- Is one of the first exclusively solar-powered microgrids in the US
- First to provide full back-up power to an emergency shelter on the distribution network
- First solar+storage microgrid to be developed on a landfill site, contributing to brownfield redevelopment efforts in Rutland, VT



- 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)



# Americans with Disabilities Act: NYC Court Ruling

- In November 2013, a federal court decided NYC failed to adequately protect the disabled during SuperStorm Sandy.
- City liable under federal Americans with Disabilities Act (ADA).
- Lack of reliable electricity alone prevents the disabled from getting the protection of public services in a severe storm
- From emergency shelters without power to stalled elevators in public housing to a lack of charging stations to power up wheelchairs & ventilators.
- Resilient power can provide the elderly & disabled access to emergency services that otherwise are denied to them in power outages.



# Resilient Power and Federal Programs- A Better Coordinated Partnership

- DOE and state grants
- EPA and community resiliency programs
- HUD and Better Building Program
- FEMA State Mitigation Plan Review (October 17 comments)
- NSA and federal facilities
- FAA and airport power
- Federal Energy Labs
- OTHERS?



# Superstorm Sandy and Our New Normal

*“Only a crisis,—actual or perceived—produces real change. When the crisis occurs, the actions that are taken depend on the ideas that are lying around...That, I believe, is our basic function: to develop alternatives to existing policies, to keep them alive and available until the politically impossible becomes politically inevitable.”*

*- Milton Friedman*



# RPP Upcoming Events and Links

- Next webinar: [Clean Energy Group Webinar: New Jersey's Energy Resilience Bank](#) – October 28<sup>th</sup> at 2 pm – sign up at <http://bit.ly/RPP-NJERB>
- Energy Storage Webinar: [ESTAP Webinar: Flow Battery Basics, Part 2](#) – October 29<sup>th</sup> at 1 pm – sign up at <http://bit.ly/ESTAP-FBatt2>
- 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).

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